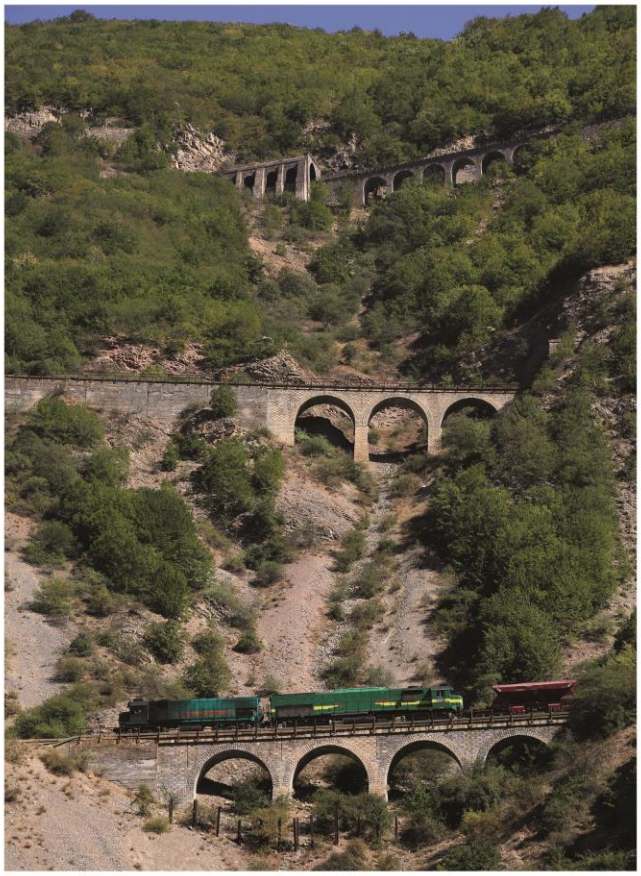
Islamic Republic of Iran
Iranian Cultural Heritage, Handicrafts and Tourism Organization
I C H H T O

Nomination of

TRANS-IRANIAN RAILWAY

for Inscription on the World Heritage List

Report



UNESCO
World Heritage Convention

Tehran 2019

In the Name of Allah; The Beneficent,
The Merciful...

Chapter 2. Description

2.a Description of Property

Introduction

In the 19th century the construction of railway as a modern industrial phenomenon was regarded of upmost importance. As a result, all countries wanted to have this new scientific achievement because of its key role in communication, innovation in transportation, easing the transfer of agricultural and industrial productions, land development as well as its security, convenience and several other aspects. Accordingly, Iranian industrialists and intellectuals came to the conclusion that the industrialization of the country very much depended on its existence. In this regard, a number of local lines in short distances were constructed under the Qajar rule but the real work only began after the end of Qajar dynasty by the construction of the Trans-Iranian railway during the Pahlavi reign in which political and economic circumstances had been improved.

As a matter of fact, since the second half of the 19th century coinciding with the Qajar rule in Iran, the spread of relations with European countries had a deep influence on the ideas of economic reconstruction and social cohesion in Iran. With the expansion of material and spiritual interactions between the east and the west and wider engagements in capitalistic associations, more attention was paid to the importance of transportation and the quality of roads on the betterment of economic, social and political conditions by Iranian intellectuals. On the other hand, the capitalist states in return also became interested in the issue of railway construction in Iran.

The increased importation of modern industries during the Qajar rule not only encountered social-economic challenges but also with a lack of required infrastructure for coordination with the global growth. Construction of roads and railways had a major role in the industrial advancement and modernization of western countries therefore the shortage of good roads and an absence of railway in Iran was considered as factors contributing to its backwardness.

Construction of the Trans-Iranian railway brought about an upheaval in the domestic economy and due to the access of Iran to high seas, marine industries were expanded thanks to the cross country rail road which also produced widespread changes in social, economic, cultural and physical-spatial spheres showing its effects on architecture and urban planning. Moreover, establishment of railway-related industrial factories, construction of multiple train stations, new routes and easier accesses, development in urban fabric, construction of streets, change in the type and craftsmanship of buildings, establishment of administrative buildings, formation of a new army, the military management of the country, provision of educational services and industrialization led to the speedy spatial-physical expansion of urban areas (Ziari, 154: 2003).

Construction of the cross country railroad as the gate for the arrival of industry and modernity to Iranian cities constitutes part of the historical memory of the country. It has several values coming from a variety of viewpoints including the cultural, historic and social aspects.

Construction of the Trans-Iranian railway was impossible without the cooperation of international companies despite a huge domestic investment and endeavor. The aim of inviting specialized companies coming from neutral states, was to secure the direct authority on construction operations by

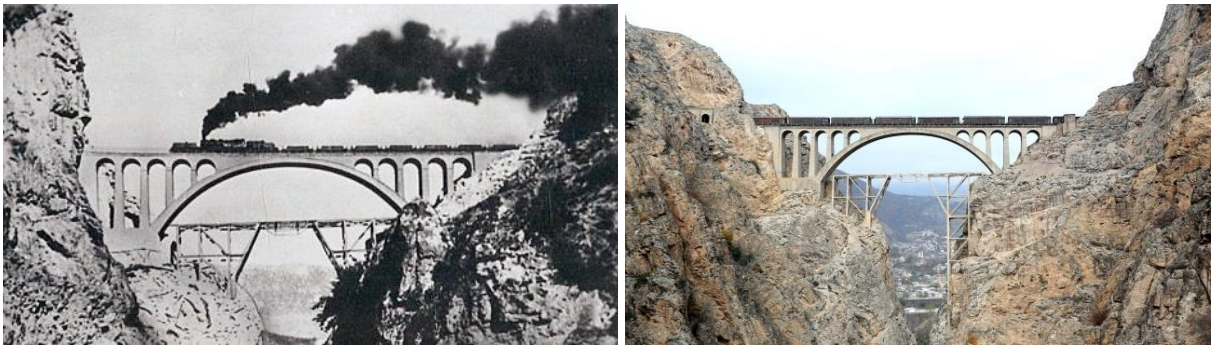
the Iranian government. In fact, contracts were made with various firms working on different segments so that the final cross country line was built with the participation of several countries.

2.a.1 The Trans-Iranian Railway

The property of Trans-Iranian railway is mainly included more than 1394 km length of railroad and a width of 1435 mm, with all related Infrastructures like bridges, tunnels, stations and access roads. The cross country railroad of Iran is a major industrial and construction masterpiece with more than 174 large bridges, 186 smaller bridges, 224 tunnels, 89 train stations and several ancillary buildings have been constructed along the route each with its special technical, technological, artistic, architectural, cultural and social characteristics . Its highest point, Nurabad in the southern line is 2217 m above sea level. The largest metal railway bridge is 1040 meter Karun Bridge in Ahwaz with 51 spans and one of the most significant bridges in the north is called Veresk which is a true bridge-building masterpiece.

Map 2.1: The Trans-Iranian Railway route cross country.

Picture 2.1: Gaduk tunnel and its aerial view.
Source: TIRRB archive.



Picture 2.2: A train is crossing over the Veresk bridge.
Source: TIRRB archive.

More than 70000 workers, engineers and experts coming from Iran and other countries took part in the construction of the Trans-Iranian railway. In excess of 20 million cubic meters of earth was removed and more than 4000 dynamites were blasted. Additionally more than 2 million cubic meters of natural or constructional stones and in excess of 500 tons of cement was used.

Thanks to the public participation in tax paying despite the hard social and political condition of the time, 46 train stations were built consisted of waiting rooms for passengers, repair rooms for locomotives and wagons, water tanks for locomotives and electricity generators for illumination.

Picture 2.3: Sorkhabad Station, (Photo by: Hamid Binaei Faal)**.**
Source: TIRRB archive.

Picture 2.4: Embankment.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Because of its economic and political importance the railway construction in Iran had been given a national priority. Passing through Alborz and Zagros mountain ranges, the line connects the Caspian Sea in the north to the Persian Gulf in the south. Beginning in 1927, construction activities ended eleven years later in 1938. Out of the 1394 km length of the cross country railroad, 852 km is on the northern segment and the remainder 542 km makes up the southern segment.[1] As planned the two lines linked at a distance of 550/542 km from Bandar-e Imam Khomeini at Sefid Cheshmeh (Fuzieh) Station which was later renamed Somayyeh (Mokammeli, 476: 2000).

[1] This segmentation is related to construction period.

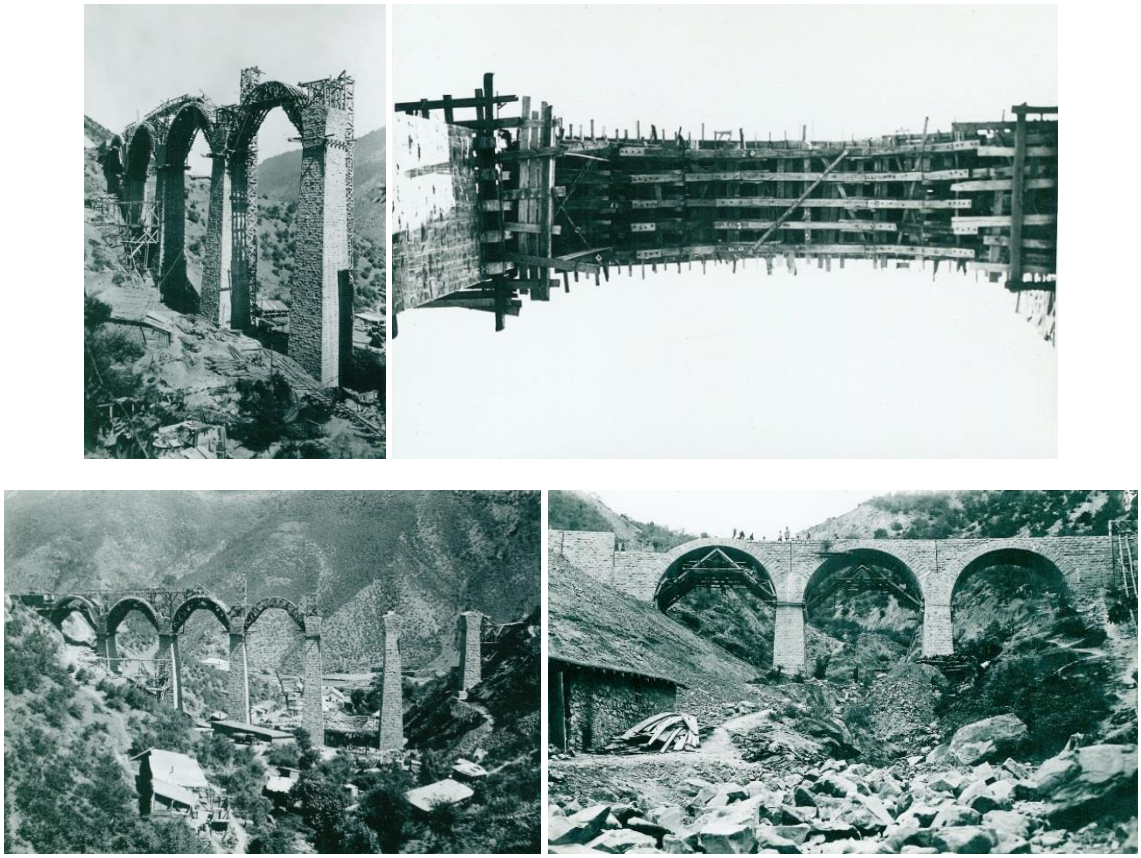
2.a.2 The Route of the Cross Country Railroad

By the time the dream of railway construction in Iran reached the point of becoming a reality, all the previous relevant plans were taken into consideration and expansive studies were conducted in order to pick the best route and its feasibility. Accordingly, a line starting from the eastern coast of the Caspian Sea and ending in the western shoreline of the Persian Gulf was given priority.

Map 2.2: The condition of railway line of Iran in 1941 between Caspian Sea and The Persian Gulf.
Source: Mokammeli, 2000.

As a matter of fact, the cross country railroad connects Bandar-e Torkaman in the north (on the southeast coast of the Caspian Sea) to Bandar-e Imam Khomeini (ex-Bandar-e Shahpur at the north coast of the Persian Gulf). The line traverses the fertile plains of Mazandaran province and enters Sari and Qaemshahr cities. Then passing through the narrow gorge of Talar in Alborz mountain range, goes through the high and hard pass of Firuzkuh via multiple tunnels and a lemniscate-shaped route. This is considered as one of the unique examples of taming the nature. Further away the line traverses a few small and large mountains or hilly areas arriving in the flat Kavir desert of Varamin and then Tehran. Going south from this point, the line enters the Qom and Arak plain and after Dorud arrives in Lorestan mountain ranges and Abdiz straits. In this region, more than one hundred kilometers of long tunnels and large bridges have been built on its course. Near Andimeshk the line enters the flat plain of Khuzestan and after passing through the suburbs of Dezful and Ahwaz cities and over the Karun River reaches the Persian Gulf.

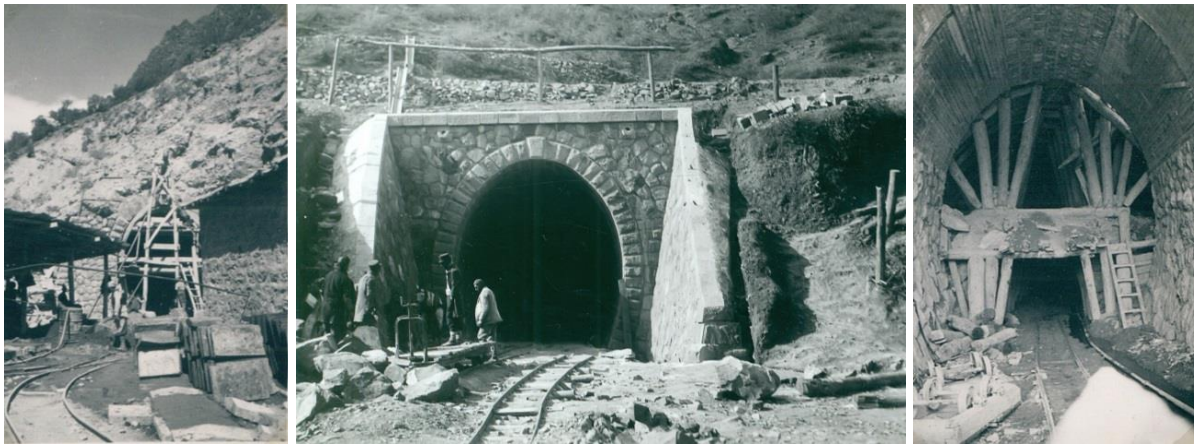
Regarding the pristine rural areas encountered on the route as well as the large tunnels and bridges built along its course, the Trans-Iranian railway not only has touristic merits but also can be considered as a modern industrial heritage attraction of Iran. Additionally, the architecture of train stations, accommodations for its staff, goods and fuel storage depots and peripheral industries on the northern line follows a simple but modern western style contrary to the southern line which follows the indigenous style of every climate and habitat that it passes through.



Picture 2.5: Constructing viaduct.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.6: Dom Dom viaduct (Left), Do-Ab viaduct (Right).
Source: TIRRB archive.

It should be pointed out that a total of 224 tunnels have been built on its route of which 93 tunnels with a total length of 23599 m are on the northern segment from Qaemshahr to Tehran and the remaining 131 tunnels with a total length of 60067 m are on its southern segment. The aggregate length of these tunnels amounts to 83666 meters.



Picture 2.7: Constructing tunnel.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.8: Tunnel between Talezang-Tang-e Panj route (Photo by: Hossein Javadi)**.**

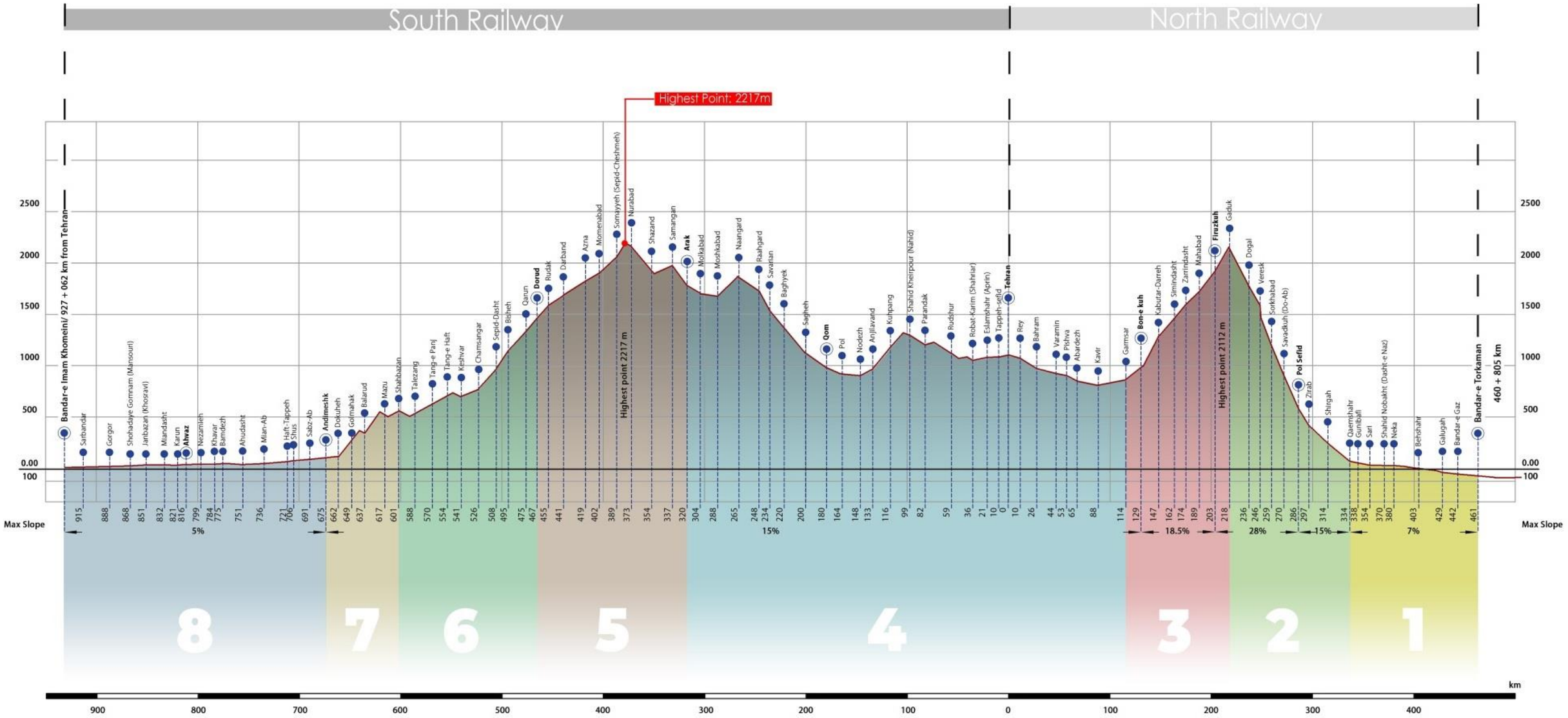
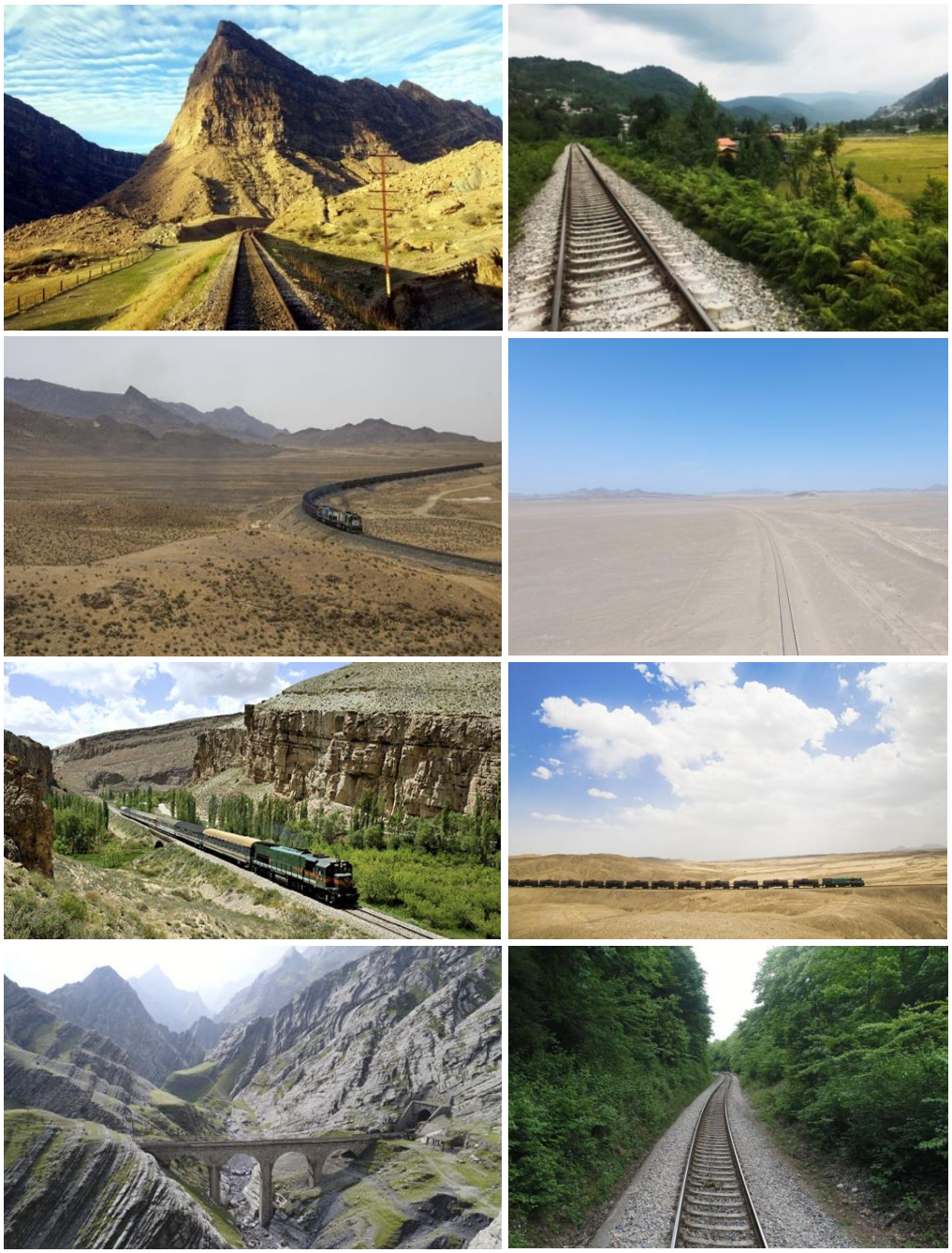


Figure 2.1: General section of the route

Harry Hacklin a railway surveying engineer writes this in his report about the north-south line: "the cross country railroad of Iran is quite interesting not only from a technical but also from a touristic point of view competing the most famous railways of the world on these two points. It is very difficult to discern which segment is more significant?: the northern section with its multiple spiral bends ascending the spectacular hillsides of Talar gorge or the Abdiz valley and its deep gorges in the southern section through which the line passes via huge bridges into scorching and impassable deserts" (The Trans-Iranian Railway: 1938, 57).



Picture 2.9: Various geographical region through the railway route.
Source: TIRRB archive.

2.a.3 The Importance of Building the Cross Country Railroad from South to North

Due to its easy access to open seas, its delivery of essential supplies to people living in southern and northern regions of the country as well as its cost-effectiveness, the cross country line from south to north of Iran is of the utmost importance. In addition to trade expansion, the national wealth increase and improving the strategic status of the country due to better communications, access to open seas also is vital for railway construction because of the necessity to carry a huge amount of heavy cargo such as rails, wagons, locomotives, machinery, etc… importations of these items by land requires a lot of time because several countries must be traversed making the job bureaucratic and uneconomic. But if the railway construction begins from a coastal point as the work progresses towards inland there will be a huge saving in the costs because all the necessary equipment can be carried by the railway.

The cross country line was planned in such a way as to pass through major cities and farmlands facilitating the carriage of foodstuff and other goods needed by the central regions from more fertile northern or southern parts of the country.

Picture 2.10: Freight train crossing over the Shahbazan viaduct.
Source: TIRRB archive.

The cost of building the south to north line was on the whole less than other routes despite the presence of several natural obstacles because it covered a shorter distance. (Mokammeli, 2000: 450, 451)

2.a.4 Geography of the Cross Country Railroad

One of the main characteristics of the Trans-Iranian railway is its geographical variety due to its considerable length. Also it goes through a vast expanse of land stretching all the way from the northeast coastline of the Caspian Sea to the southwest shores of the Persian Gulf spreading over a large area with a high degree of climatic variety.

Picture 2.11:General view of the railway route in Lorestan (photo by: Hossein Javadi)**.**

Picture 2.12: The train on the southern route (photo by: Hossein Javadi)**.**

Picture 2.13: Various geographical characteristics along the railway (photo by: Hossein Javadi)**.**

2.a.4.1 Natural Characteristics

Expansion of transportation networks in each area very much depends on a variety of factors. Among the most important of these factors are natural and geographical as well as human and climatic ones which make the Trans-Iranian railway quite outstanding. The natural characteristics of the line include: its inclusion of various land, sea, and mountain and desert ecosystems containing different species of life, seas, rivers, ponds, forests and pastures which are the constituents of the natural environment of the route. Each one of these natural elements somehow have an effect on the creation of life-sustaining conditions around the route.

Despite the fact that a vast area of Iran is consisted of semi-dry, desert or high plateau areas, the northern and southern seashores have in contrast created special environments boasting rich natural resources.

In general the land of Iran is situated in an area surrounded by high mountains sitting between two large seas to its north and south. Also it contains hundreds of thousands of square kilometers of desert lands (internal factors). Additionally its relative proximity to Europe, the Mediterranean Sea, the Sahara, the Indian Ocean, inland heights of Asia and Siberia (external factors) produces a climate variety rarely seen in other countries. Its temperature fluctuates from below 30 degrees Celsius in mountainous regions to above 60 degrees Celsius in its central deserts or some of its southern areas. Its average annual precipitation varies from below 5 cm to near 2 meters depending on the climate. The southernmost point of Iran is only 1-2 degrees above the Tropic of Cancer making the southern areas remain warm throughout the year. On the other hand its northern areas (with the exception of Caspian Sea shorelines) and its mountainous regions are rarely hot in summers instead mostly have freezing temperatures 3-4 months of the year.

The effect of nearness to the sea can be vividly seen by comparing the high rainfall and rich vegetation of the densely populated northern seashores of Iran with the arid deserts and almost unpopulated areas of central Iran. Location of mountain ranges in front of or in parallel to winds and air currents is another factor constantly effective on weather changes. For example, in mountain ranges standing against humid winds, precipitation and vegetation on the anterior and posterior sides is very different. For this reason the vastness of Iran is regarded as an effective factor on the manner of its transportation network expansion (including its railway network) and the creation of beautiful views along the cross country line. Acknowledging the presence of such diversity makes us understand the reason for using

special techniques as well as structural and engineering innovations required in the harsh conditions of various climates existing along the route.

2.a.4.2 The Climatic Variety along the Cross Country Railroad

According to climatic divisions, Iran has four climates: humid and temperate (southern shorelines of the Caspian Sea), cold (Alborz and Zagros mountains), arid and warm (the central plateau) and humid and hot (the southern sea coast). The Trans-Iranian railway passes through all of these divisions creating a comprehensive climatic connection. Additionally, along the route specific regional climates exist because of local geographic characteristics of the line. Actually the route has been subdivided based on these local climates. On the whole, different areas located along the route have been grouped into eight specific climates.

Picture 2.14: Climate variety along the railway.
Source: TIRRB archive.

Traversing high mountains, vast plains, coastal areas, forest regions, etc…, the Trans-Iranian railway covers a wide expanse of various climates including: cold and mountainous, wet and temperate, warm and dry, hot and humid as well as local microclimates.

Picture 2.15: Saleh hamid viaduct, Tang-e Haft to Tang-e Panj route (Photo by: Ms. Atefeh Momen)**.**

Picture 2.16 :Shahbazan – Talezang route.
Source: TIRRB archive.

The Trans-Iranian railway begins from north of Bandar-e Torkaman on the southeastern seacoast of the Caspian Sea and after going through Sari and Qaemshahr which are cities on the Mazandaran plain, enters mountainous regions of Alborz and passing through multiple tunnels and bridges built at the high strait of Firuzkuh, reaches Tehran via Varamin Plain. Further away the line traverses the flat lands near Qom and Arak and after crossing Dorud Station, enters the tunnels and bridges built into the Lorestan highlands. At Andimeshk, the line arrives in the flat plain of Khuzestan and bypassing

Dezful, enters Ahwaz and passes the grand bridge of Karun. Further down it terminates at Bandar-e Imam Khomeini on the south.

The climatic variety exist in both sections of the line i.e. the northern and the southern sections each with four characteristic climate of its own.

Picture 2.17: General view of the railroad.
Source: TIRRB archive.

Picture 2.18: Gaduk-Veresk route (Left), Do-Ab viaduct (Right).
Source: TIRRB archive.

Briefly, while the Trans-Iranian railway is nominated as a single site, only for the purpose of the description, the route of the Trans-Iranian railway is divided into eight sections according to: climatic variety, natural views, topography and weather conditions.

Region	length	Location	Route	Climate	Agriculture & Sources
Bandar-e Torkaman- Qaemshahr	127 kilometer	Eastern plain of Mazandaran	Bandar Torkaman, Bandar Gaz, Sari & Qaemshahr provinces	Warm& humid- Fertile	Rice, cotton, tobacco
Qaemshahr Gaduk	115 kilometer	Northern slope of Alborz mountain	Summit &climax of Gaduk with the height of 212 meter above the sea	Mild & humid	Rice, wheat, coal's mines
Gaduk- Garmsar	104 kilometer	Southern slope of Alborz mountain	Firuzkuh, Hablehrud valley and desert of Garmsar	Mild& dry	Wheat
Garmsar-Tehran	439 kilometer	Central plateau	Varamin, Tehran, Qom & Arak	HOT	Wheat, beetroot & the other food
Arak - Dorud	147 kilometer	Arak	Hills& rising ground	Mild& dry	-
Dorud- Shahbazan	138 kilometer	Southern Zagros mountain	Along the rivers of Abdiz & Ab si zar'	Hot and dry	Arid
Shahbazan- Andimeshk	74 kilometer	Mountain of Khoram abad	along the hollows - hills and valleys	Hot& dry	Arid
Andimeshk- Bandar-e Imam Khomeini	250 kilometer	Lorestan's mountains & Khozestan's plain	Rivers of Balarud, Abdiz & Karun	Hot	Wheat, cotton and the other products of tropical region

Table 2.1: Climatic Zoning of the Trans-Iranian Railway.

Map 2.3: Location of Climatic Zoning of the Trans-Iranian Railway.

Zone 1: Bandar-e Torkaman- Qaemshahr

Caspian Sea

Persian Gulf

Bandar-e Torkaman

Qaemshahr

Zone 1

Gonbad-e Kavus

Gaduk

Garmsar

Arak

Dorud

Shahbazan

Andimeshk

Bandar-e Imam Khomeini

Mian Kaleh

Bandar-e Amir Abad

Mehtar Kalateh Airport

Bandar-e Gaz

Galugah

Behshahr

Neka

Shahid Nobakht (Dasht-e Naz)

Sari

Gunibafi

Roshankoh

Sari Station

Bandar-e Torkaman

AXE STATION

VERS SARI

Zone 1:

Length: 127 km

Station: 9

Figure 2.2: Zone 1, Bandar-e Torkaman – Qaemshahr

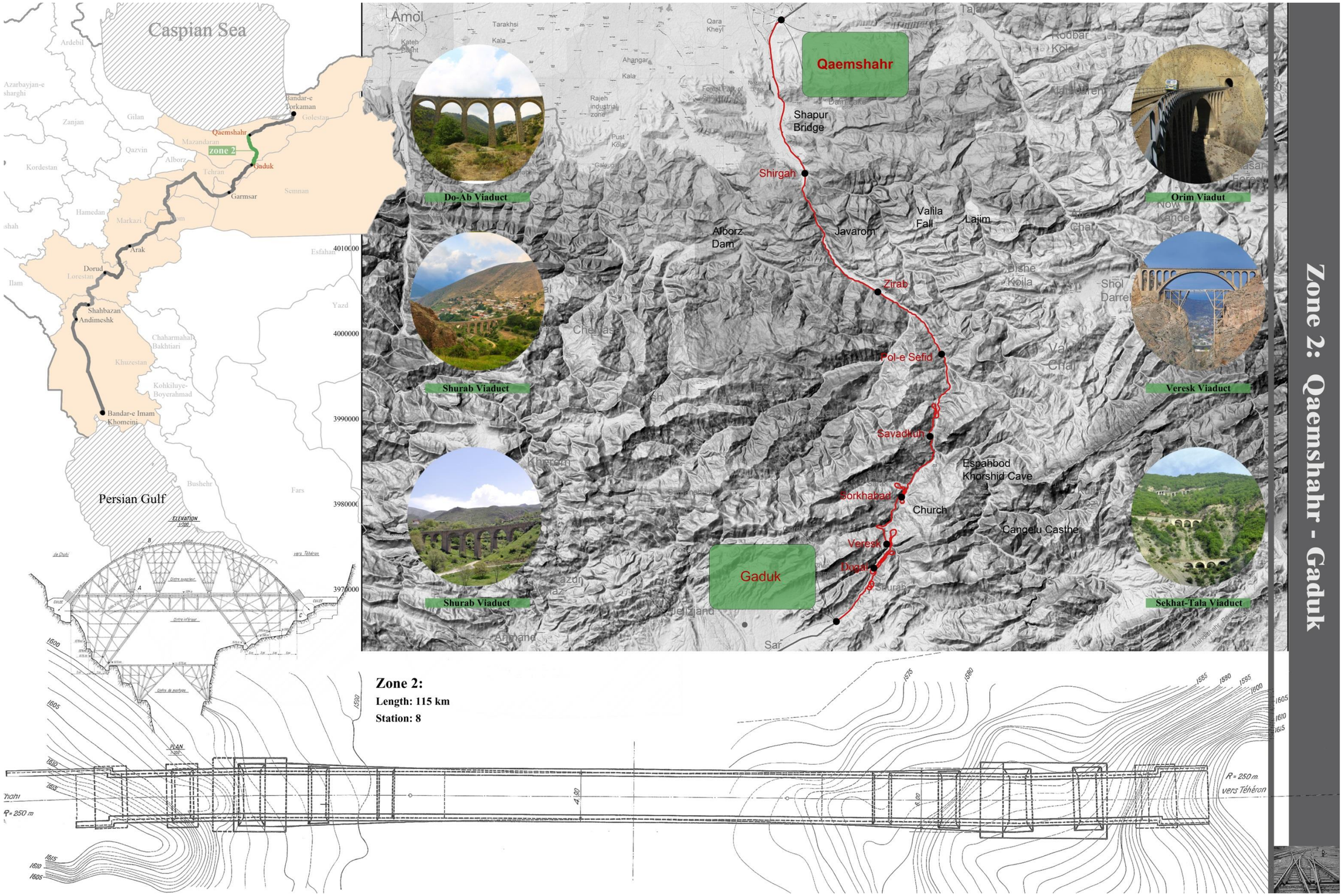


Figure 2.3: Zone 2, Qaemshahr – Gaduk

Zone 3: Gaduk - Garmsar

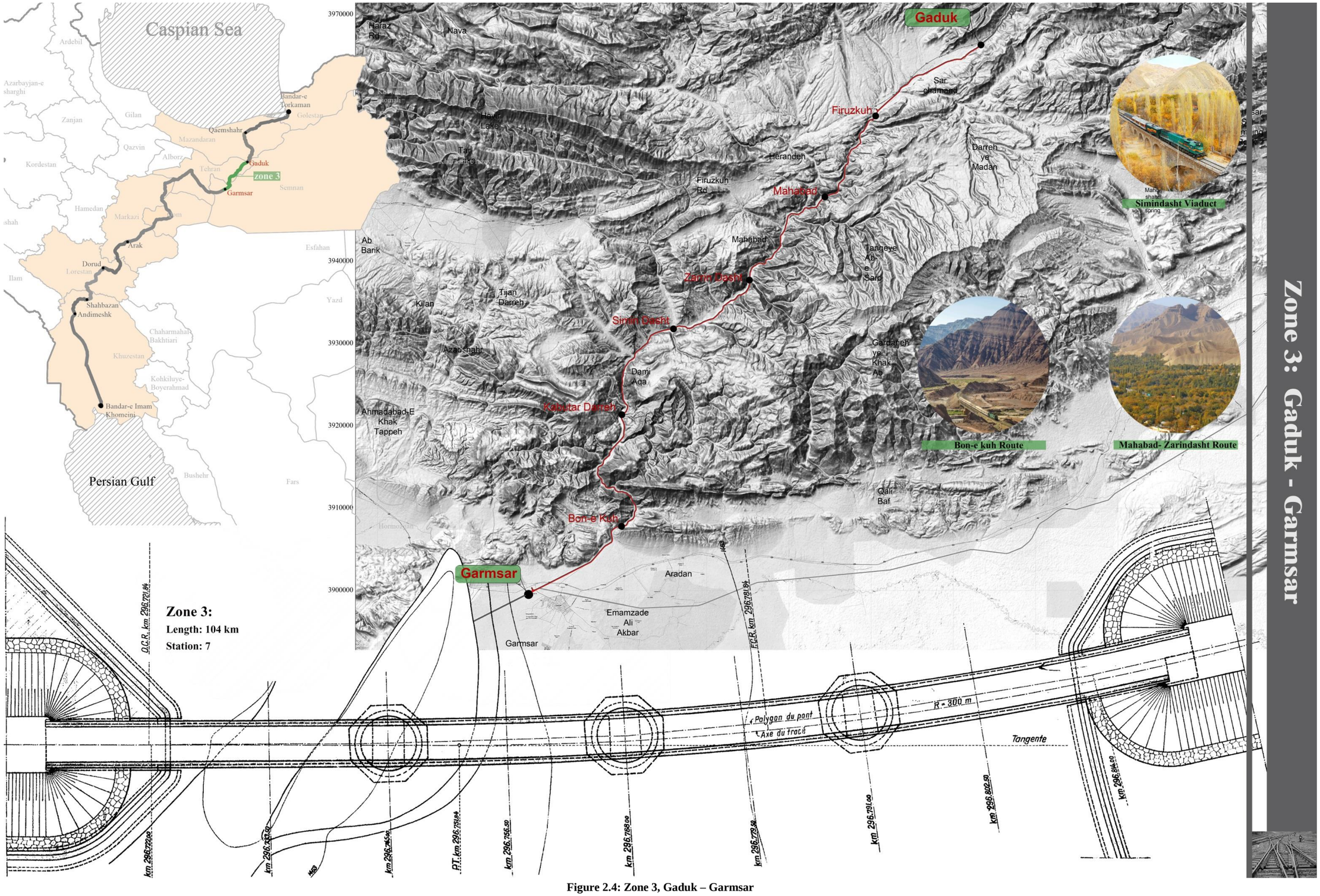


Figure 2.4: Zone 3, Gaduk – Garmsar

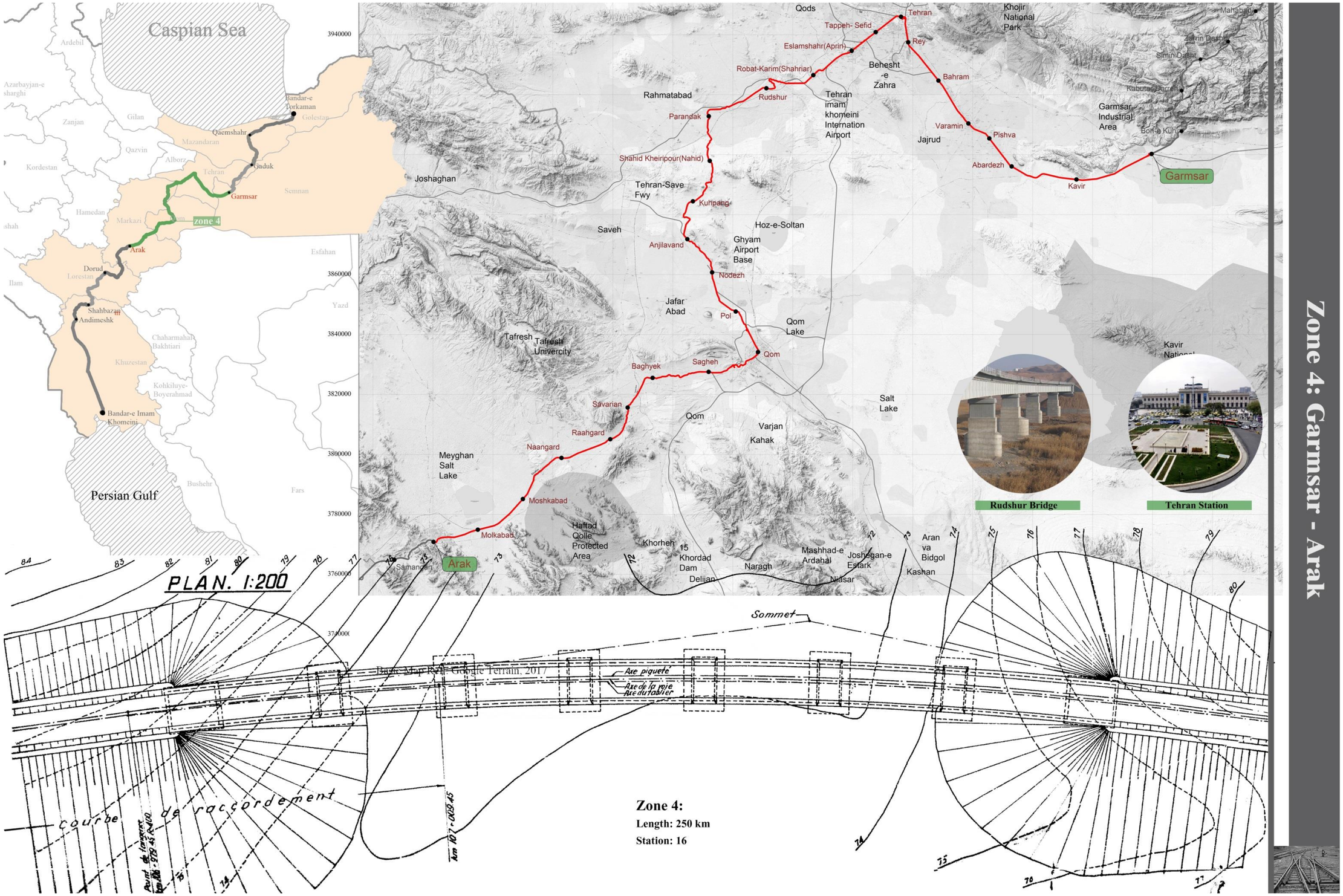
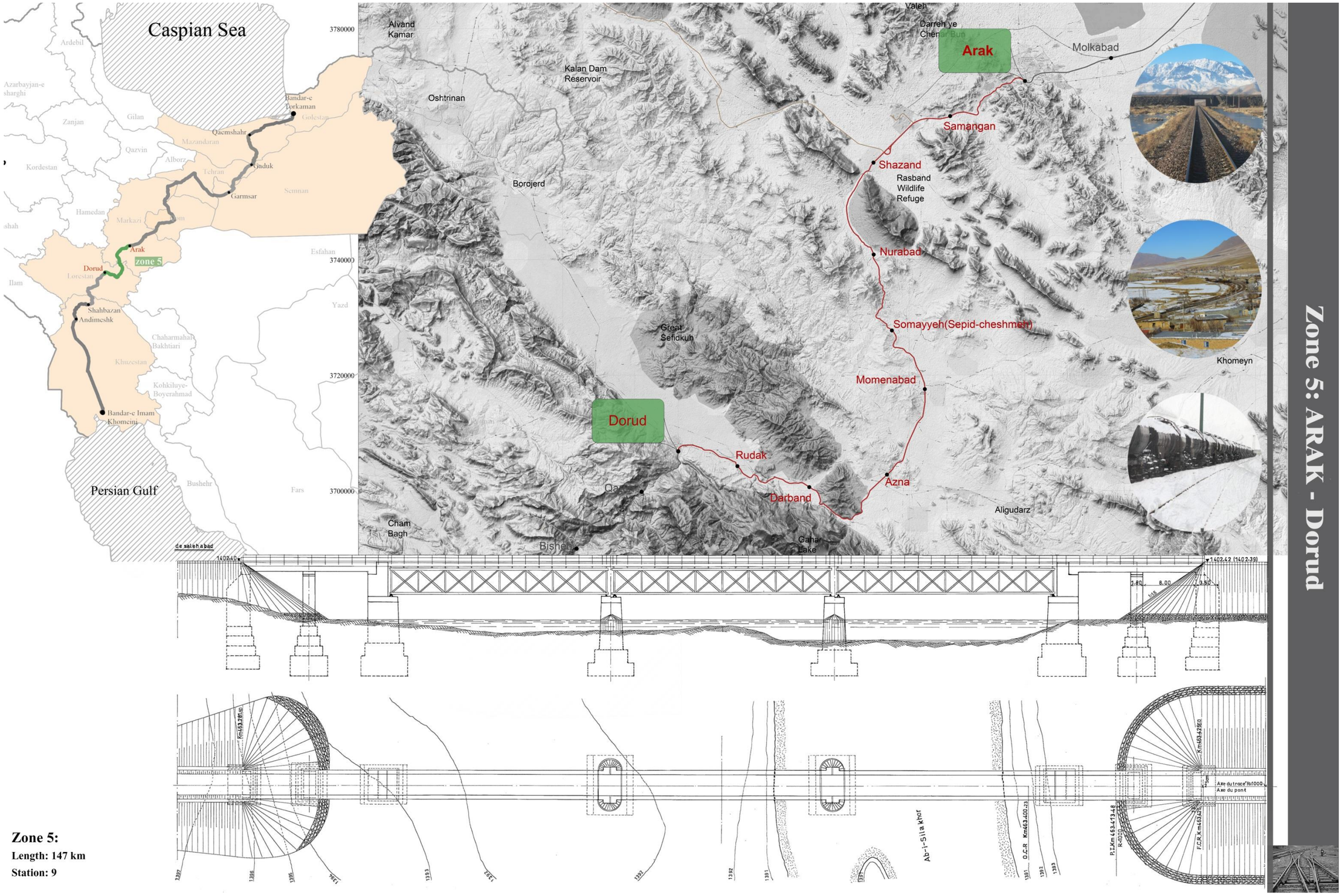


Figure 2.5: Zone 4, Garmsar – Arak

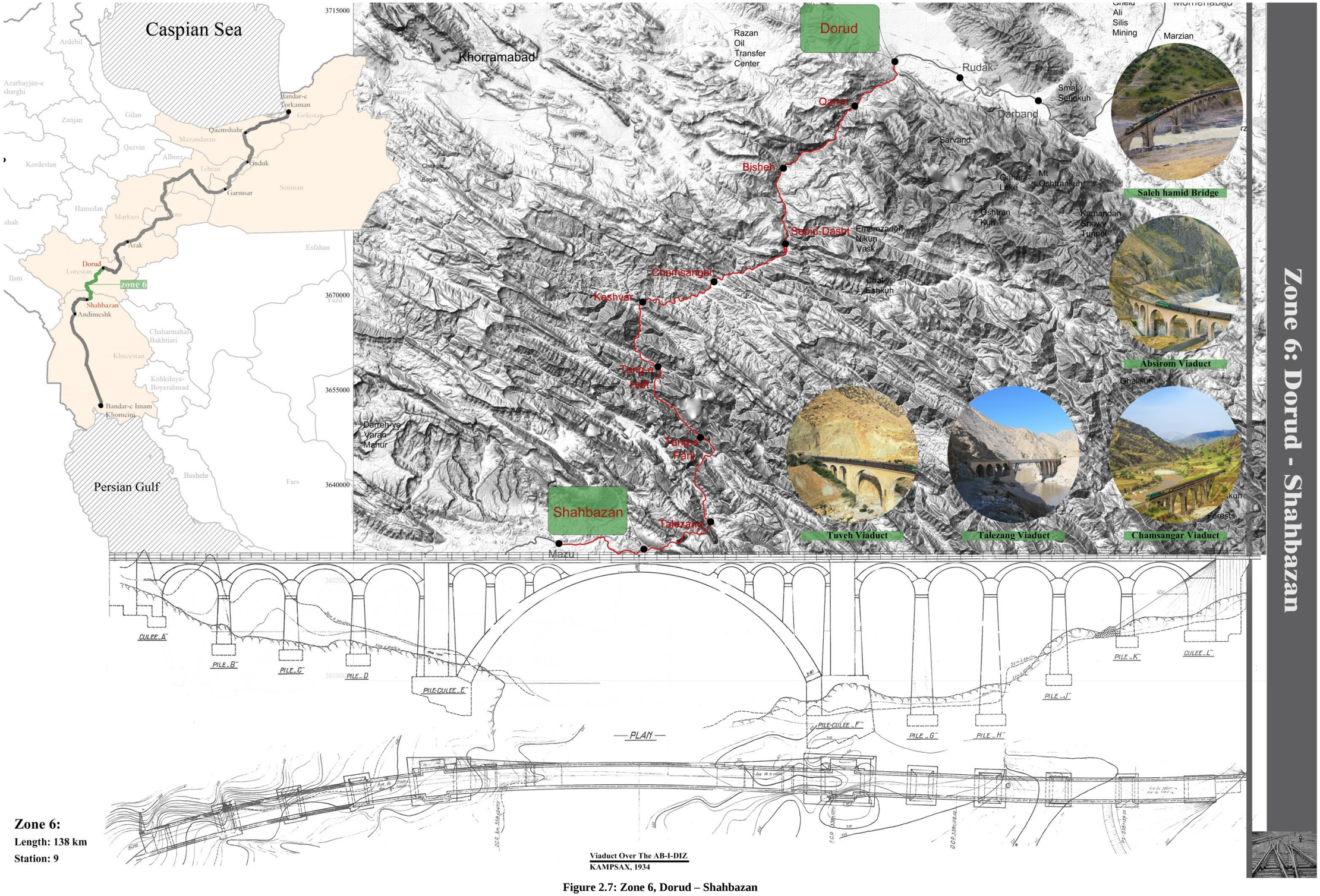


Zone 5:

Length: 147 km

Station: 9

Figure 2.6: Zone 5, Arak – Dorud.



Zone 6:
Length: 138 km
Station: 9

Figure 2.7: Zone 6, Dorud – Shahbazan

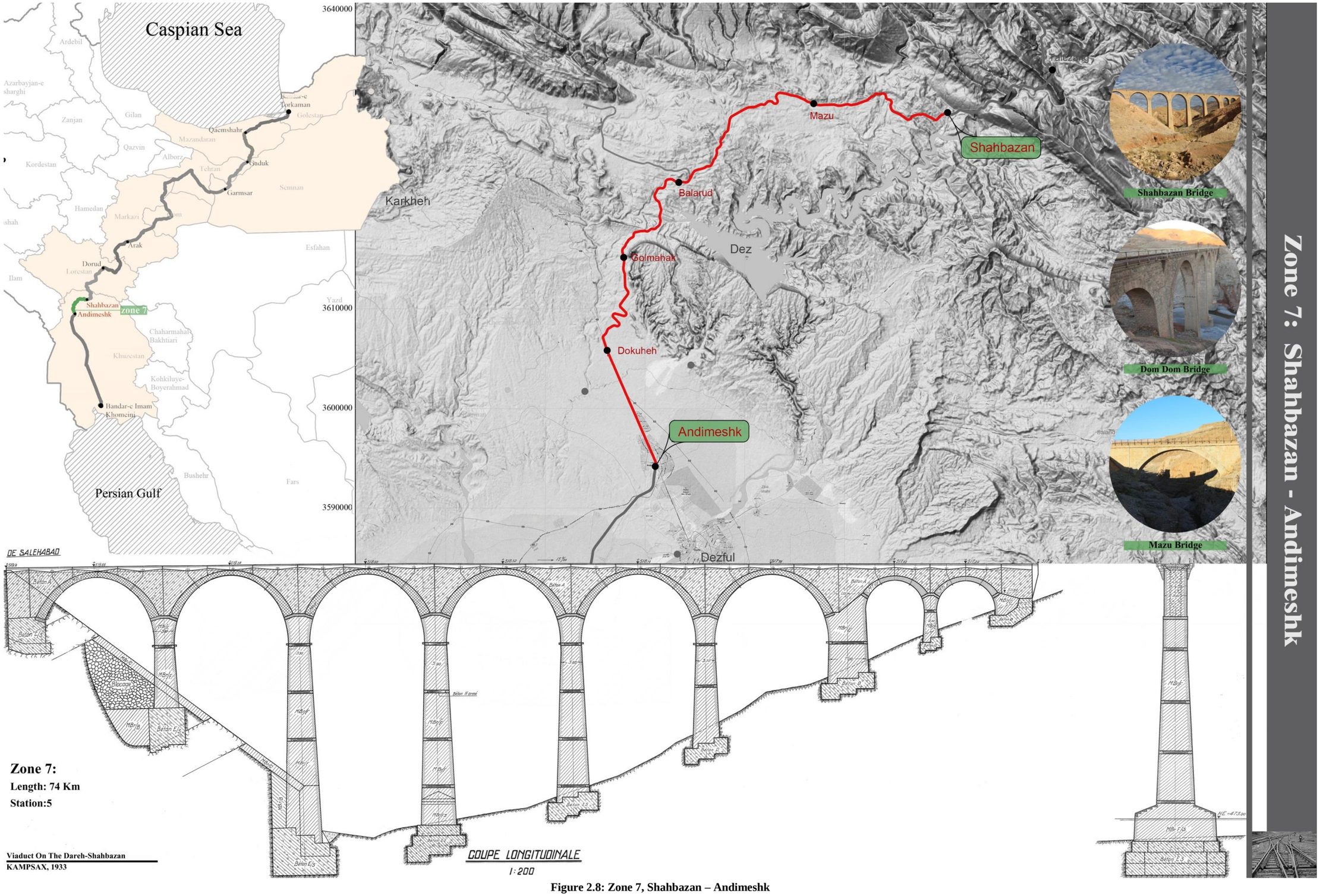
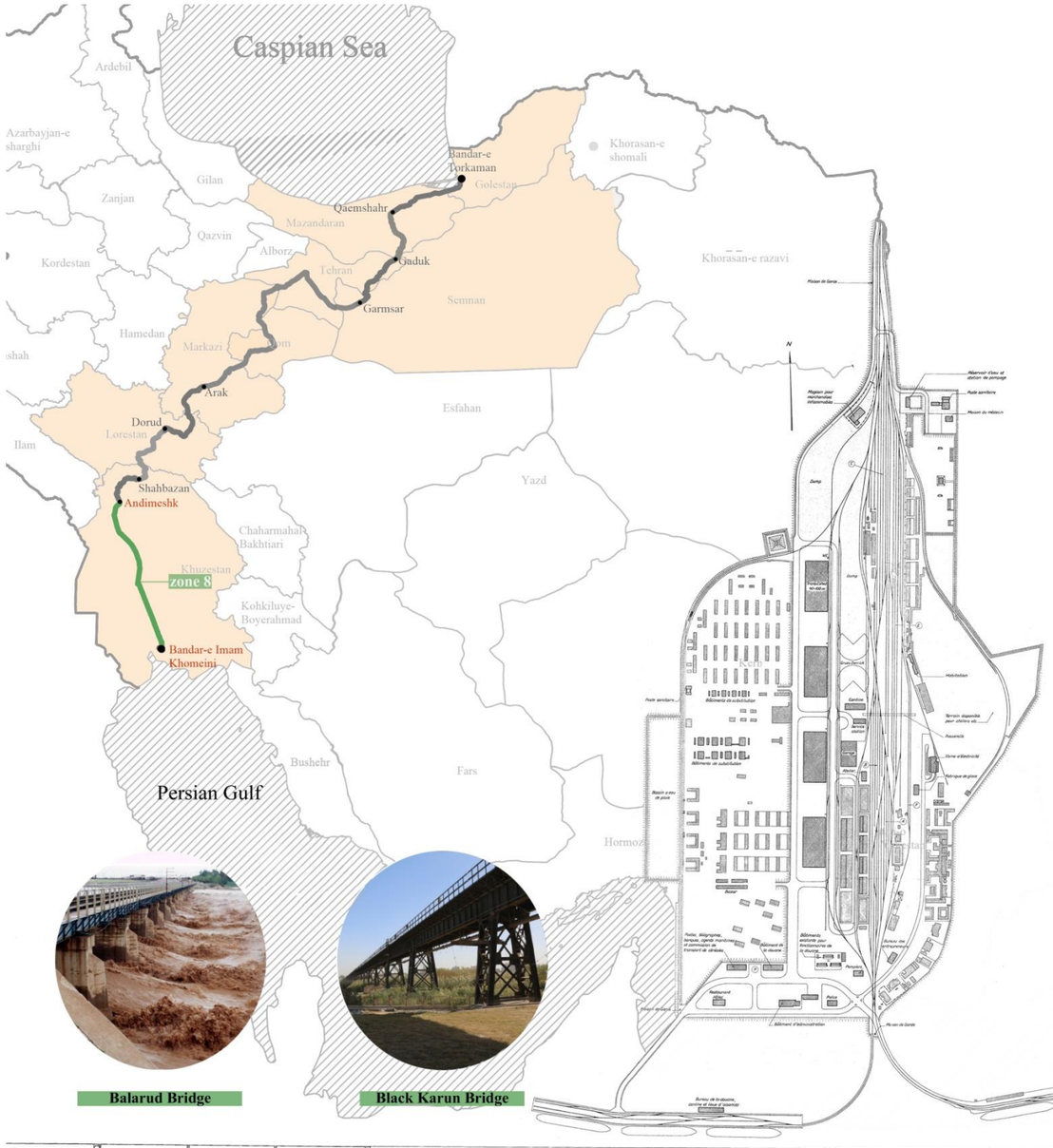
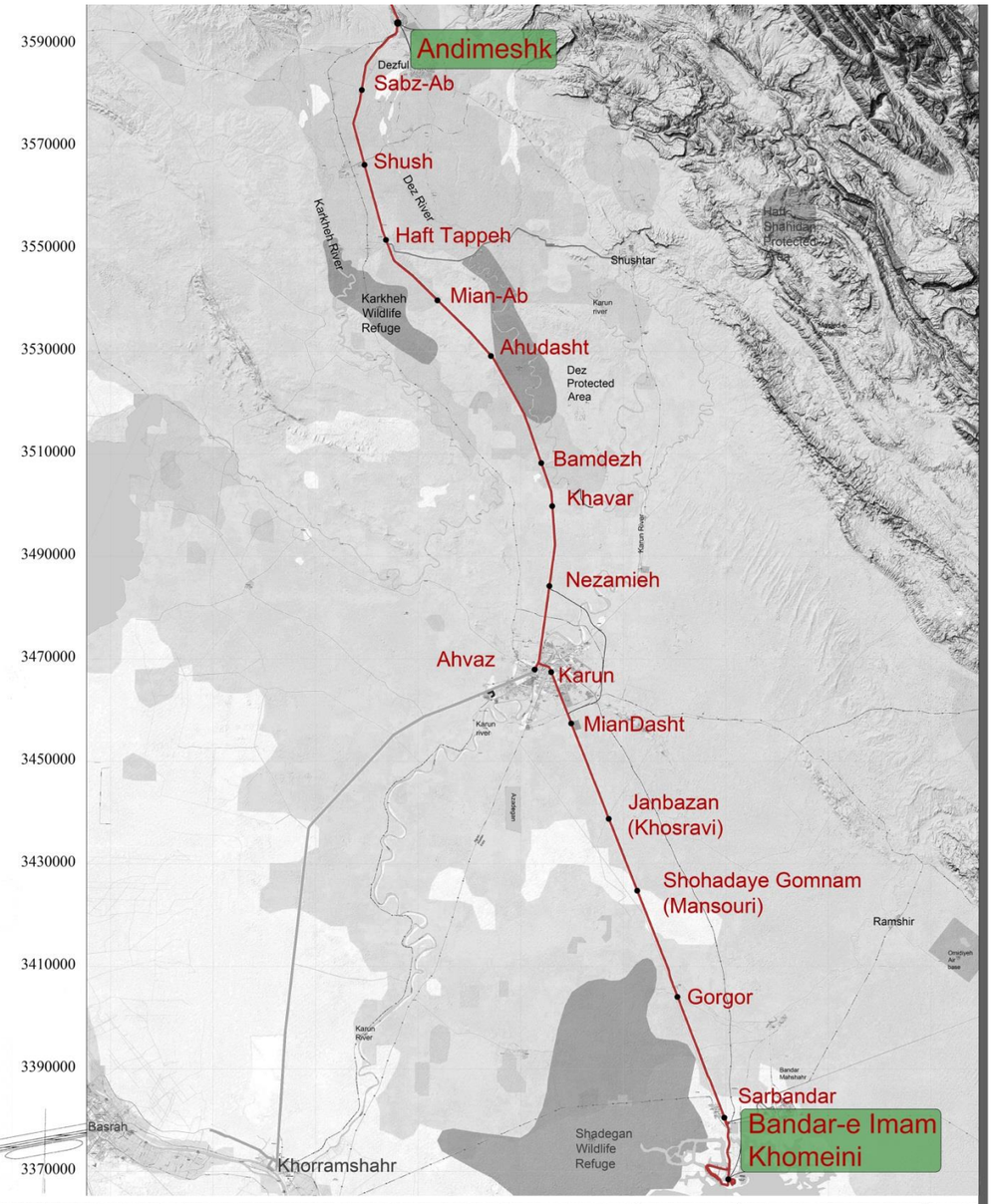
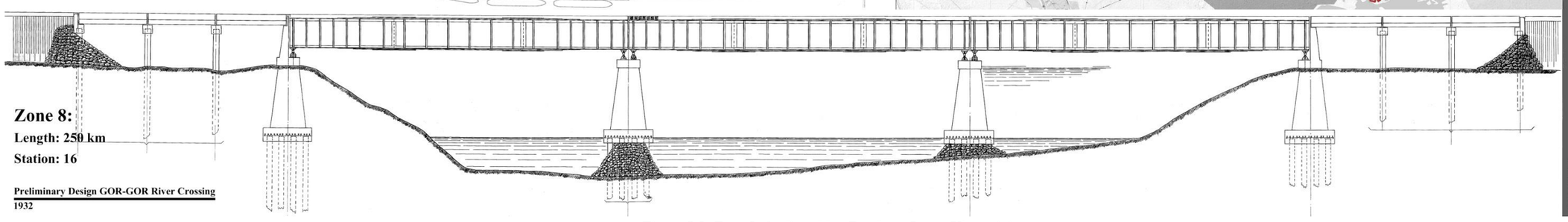


Figure 2.8: Zone 7, Shahbazan – Andimeshk







Zone 8: Andimeshk - Bandar-e Imam Khomeini

Figure 2.9: Zone 8, Andimeshk – Bandar-e Imam Khomeini

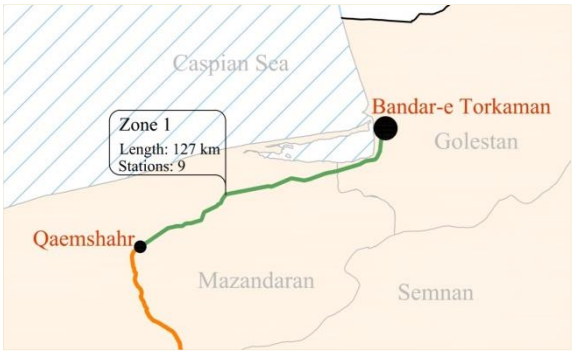
Picture 2.19: Lorestan route (Photo by: Hossein Javadi)

Picture 2.20: Bon-e Kuh to Kabutar-Darreh route (Photo by: Hossein Javadi)**.**

Picture 2.21: General view of the Trans-Iranian railway (Photo by: Hossein Javadi)**.**

2.a.4.2.1 Bandar-e Torkaman – Qaemshahr

The first section of the railway route on the northern part is the 127-km distance between Bandar-e Torkaman and Qaemshahr. Situated in Behshahr (Ashraf-e Mazandaran) plain, the region has a warm and humid climate and rice, tobacco, cotton and citrus are planted in its fertile farmlands.



Map 2.4:Bandar-e Torkaman to Qaemshahr route.

Picture 2.22: Suburban train of the Northern route (Bandar-e Gaz to Behshahr) (Photo by: Hossein Javadi)**.**

Picture 2.23: Bandar-e Torkaman – Qaemshahr (Left), Bandar-e Torkaman Station (Right).
Source: TIRRB archive.

2.a.4.2.2 Qaemshahr – Gaduk

The second section of the northern route covers the 115 km-long distance between Qaemshahr and Gaduk. Traversing the northern mountainsides of Alborz, spectacular landscapes can be seen along this section. The thickly-forested region has deep gorges and high mountaintops (photo of the northern axis). For example the heighest point of north route is related to Gaduk tunnel. Its height is 2112 meters above sea level.

Map 2.5: Qaemshahr – Gaduk route.

Picture 2.24: Orim bridge and its aerial view (Photo by: Mohammad Nikaeen)**.**

Picture 2.25: A constructing bridge (Left) and a tunnel on the Northern route (Right).
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Therefore railway construction on the route requires a lot of bridging over valleys and tunneling into mountains. In this humid and temperate climate, wheat and rice is planted. Coal is the main mine of the region.

Picture 2.26: Constructing bridges.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

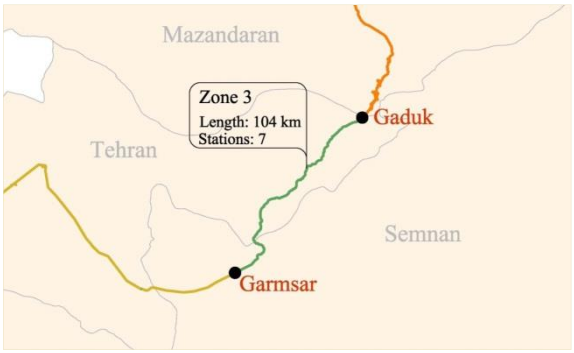
Picture 2.27: Constructing of Veresk viaduct, 1933 (Left), Veresk viaduct, (Right).
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Left), TIRRB archive (Right).

Picture 2.28: Veresk viaduct.
Source: TIRRB archive.

Picture 2.29: Se-khat-e-Tala viaduct.
Source: TIRRB archive.

2.a.4.2.3 Gaduk - Garmsar

With a length of 104 km, the third section of the northern route is located on the southern mountainsides of Alborz. After Firuzkuh, the line passes through Hablehrud valley in which farmlands are seen all the way as far as Simindasht station, then it enters the desert of Garmsar which is mountainous and barren. The third section has a dry and temperate climate and its main crop is wheat. At the end of the route a salt desert is seen.



Map 2.6: Gaduk – Garmsar route.

Picture 2.30: Gaduk Tunnel.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Left), TIRRB archive (Right).

Picture 2.31: Firuzkuh – Mahabad (Photo by: Hossein Javadi)**.**

2.a.4.2.4 Garmsar – Tehran – Arak

The fourth and final section of the northern line is 439 km and connects Garmsar to Tehran and Arak cities. The railroad traverses the central plateau of Iran which is partially fertile but mostly barren and arid. Qom and Varamin cities are also on the route. With its warm and dry weather, wheat and beet are its main crops.

Map 2.7: Garmsar - Arak route.

Picture 2.32; Construction process of Tehran Station (Left), Tehran Station (Right).
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Left), TIRRB archive (Right).

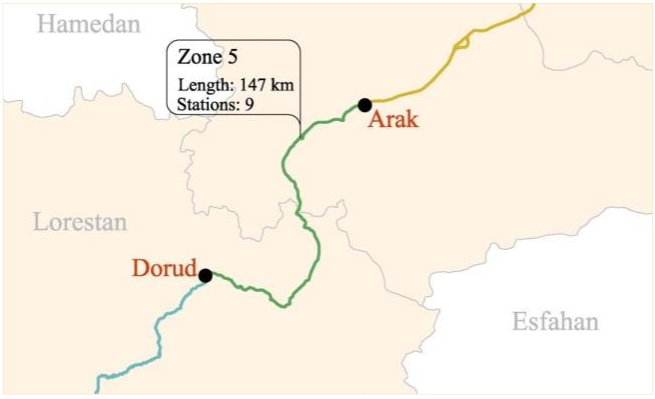
Picture 2.33: Southern region route.
Source: TIRRB archive.

Picture 2.34: : Arak station.
Source: TIRRB archive.

Picture 2.35: A viaduct along the Qom – Arak route.
Source: TIRRB archive.

2.a.4.2.5 Arak – Durud

With a length of 147 km, this is the first section of the southern line. Because of its hilly terrain, at some points the construction of half-tunnels or mountain cutting became necessary. The highest point of the Trans-Iranian railway is located on this section in the vicinity of Nurabad station with a height of 2217 m above sea level. The weather is dry and temperate with heavy snowfall in highlands.



Map 2.8: Arak – Dorud route.

Picture 2.36: Somayyeh station (Photo by: Hossein Javadi)**.**

2.a.4.2.6 Dorud – Shahbazan

The second section of the southern line is the 138 km distance between Dorud and Shahbazan. All along the railway line, Abdiz River and Absizar (also known as Sezar) which is one of its branches are seen. Passing through twelve large straits or gorges in southern Zagros Mountains, the second southern section was considered as the hardest and costliest part of the cross country railroad. Presence of the high mountains of Lorestan as well as well-watered rivers on the path required the construction of several tunnels, bridges, galleries and technical structures. The barren and mountainous region in this part has a warm and dry weather.

Map 2.9: Dorud – Shahbazan route.

Picture 2.37: Shahbazan (Left and Down-right) and Dom Dom (Up-Right) viaducts.
Source: TIRRB archive.

Picture 2.38: Cross Country railroad to Bisheh (Up-Left), Constructing Sezar bridge (Up-Right) & Qaleh sheikh (Mazu) viaduct on the way of southern region.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.39: Saleh hamid viaduct.
Source: TIRRB archive.

Picture 2.40: Train on the Dom Dom viaduct (Left), Constructed Talezang bridge after war (Right).
Source: TIRRB archive.

Picture 2.41: On the way of Shahbazan to Talezang. (Photo by: Hossein Javadi)**.**

Picture 2.42: Bisheh Station (Photo by: Hossein Javadi)**.**

Picture 2.43: Bisheh falls around Bisheh station (Up), Lorestan district on Bisheh – Qarun route (Down)
(Photo by: Hossein Javadi)**.**

Picture 2.44: Absirom viaduct. (Photo by: Hossein Javadi)**.**

2.a.4.2.7 Shahbazan – Andimeshk

The 74 km long third section of the southern line has a rugged terrain with deep gorges almost everywhere. The route is barren with hot and arid weather.

Map 2.10: Shahbazan – Andimeshk route.

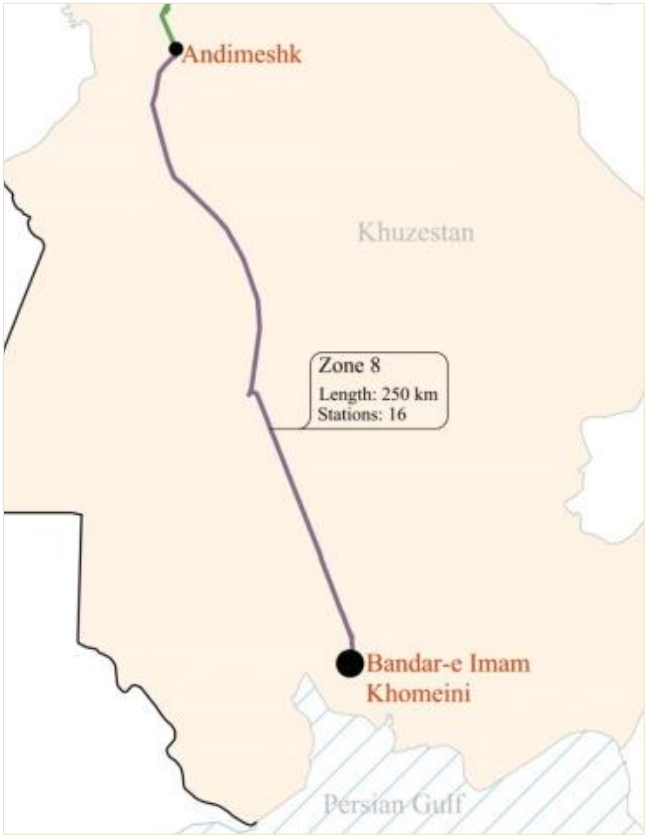
Picture 2.45: Golmahak station (Photo by: Mohammad Nikaeen)**.**

Picture 2.46: Andimeshk – Shahbazan route (Photo by: Hossein Javadi)**.**

Picture 2.47: Mazu bridge (Up), Dom Dom viaduct (Down) (Photo by: Hossein Javadi)**.**

2.a.4.2.8 Andimeshk- Bandar-e Imam Khomeini

The final section of the line passes through these two cities and has a length of 250 km. Crossing Balarud, Abdiz and Karun rivers, the line enters the fertile and flat plain of Khuzestan. Further on it passes through Ahwaz and its huge metal bridge on Karun and reaches Bandar-e Imam Khomeini on the Persian Gulf as its southernmost destination. In the blazing hot weather of the region, wheat, cotton and tropical crops are planted.



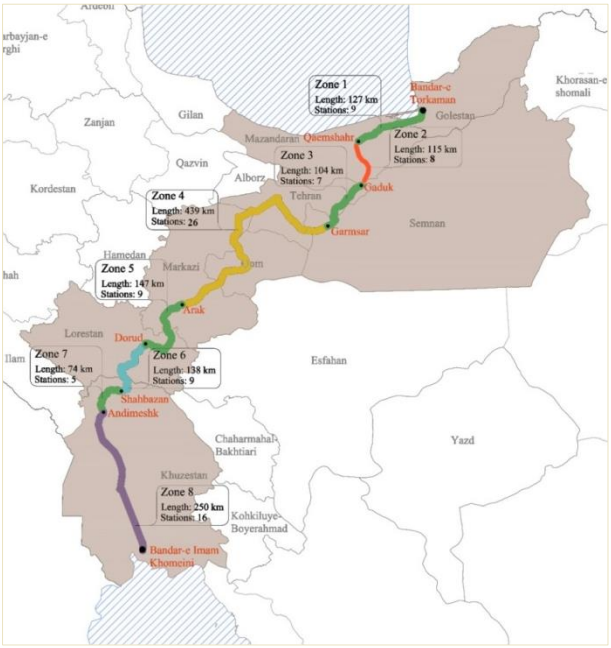
Map 2.11: Andimeshk – Bandar-e Imam Khomeini route.

Picture 2.48: Karun bridge (Also known as Pol-e Siah)
Source: TIRRB archive.

Picture 2.49: Ahwaz – Bandar Imam Khomeini route (Hossein Javadi).

2.a.5 Regions of the Cross Country Railroad

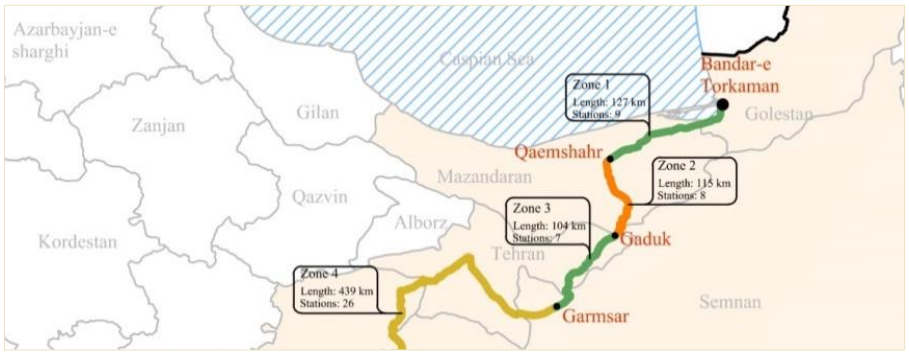
The Trans-Iranian Railway is a long cross country line linking the southwest to the northeast of Iran. Its northernmost point is Bandar-e Torkaman (formerly known as Bandar-e Shah) and its southernmost point is Bandar-e Imam Khomeini (former Bandar-e Shahpur). As initially planned, construction activities of the line started on both directions and extended inland simultaneously practically dividing it into the southern and northern lines which are still called as such. The northern line connects Bandar-e Torkaman to Tehran and is 461 km long and the southern line connects Tehran to Bandar-e Imam Khomeini and has a length of 933 km, thus the total length of the cross country railroad amounts to 1394 kilometers. Each of the lines and their characteristics are briefly discussed below.



Map 2.12: Various regions of the cross country railroad.

2.a.5.1 The Northern Line (Bandar-e Torkaman to Tehran)

On the northern segment of the cross country railroad, Bandar-e Torkaman and Tehran are linked. 150 km out of the 461 km long railway (as far as Shirgah Station) traverses the fertile Mazandaran Plain passing through Bandar-e Gaz, Behshahr, Sari and Shahi. The northern line has 27 stations, 1500 small and large bridges with a total length of approximately 6850 meters. Its largest bridge is Veresk and its longest tunnel is Gaduk which with a length of 2887 m is the longest tunnel existing on the whole line too.



Map 2.13: The northern line (Bandar-e Torkaman to Tehran).

Bandar-e Torkaman: the port is located on Gorgan Bay and among its advantages compared with Bandar-e Gaz or other points nearby are: its higher water depth and its better-protected harbor from strong waves. The port had a wooden jetty with a length of 1490 meters in which large ships could easily dock. Thanks to the construction of the railway terminal, Bandar-e Torkaman became more urbanized and its economy became highly dependent on railway and cargo shipping.

Picture 2.50: General view of northern line (Photo by: Hossein Javadi)**.**

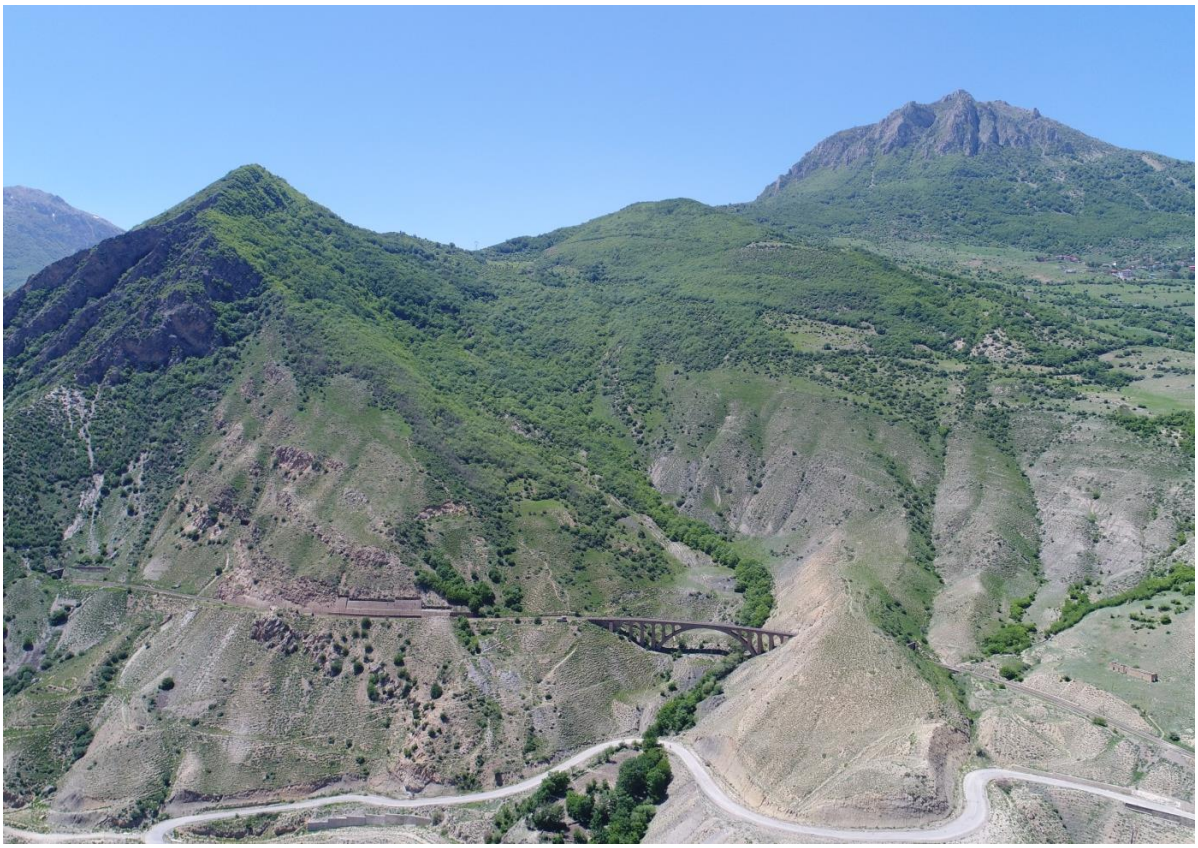
Picture 2.51: Bandar-e Torkaman station (Photo by: Hossein Javadi)**.**

Located in the west of Golestan Province, Bandar-e Torkaman spreads over an area of 1783 km^2 and is 20 meters above sea-level. Its geographical coordinates are between 53-54 degrees, 25-55 minutes east longitude and between 36-37 degrees, 23-50 minutes north latitude. Local people living in the region were of the Torkmen race which is a branch of the central-Asian Turks called Aquz or Qoz. Since ancient times the tribe lived a nomadic life in vast deserts situated between Seyhun River and the Aral Sea. Until around 7^{th} century AD, Torkmens were part of the great race of Turks.

The historical wall of Gorgan stood near this port. The great wall of Gorgan or the Red Wall (also called the Red Snake in ancient texts) is a historical wall beginning from Gomishan area on the Caspian Sea and running all the way to Golbodaq Mountains northeast of Kalaleh. Unfortunately almost the entire wall has been destroyed and only small parts of it remain buried under the ground. In fact the historical wall of Gorgan was one of the largest defensive walls on earth second only to the Great Wall of China. The 200-km long wall has been registered as a national monument on 1999.

Picture 2.52: Ancient great wall of Gorgan.
Source: TIRRB archive.

Mazandaran: spreading over an area of 23756/ 4 km^2 the Mazandaran Province is located at north of Iran neighboring the Caspian Sea to its north, Tehran and Semnan provinces to its south, Gilan Province to its west and Golestan Province to its east. Its topography can be easily divided into plain and mountainous regions. Created by the Alpine orogenic of the tertiary age, the Alborz Mountains stand as a long and high wall separating seaside plains from the rest of Iran. The eastern half of the western Alborz, the whole central Alborz and part of the eastern Alborz are within the limits of the province. In its path, the northern line runs through both the plain and the mountainous parts of Mazandaran. After Shirgah, the line enters a forest region extending as far as Sorkhabad and on the upstream of Talar passes through Zirab, Pol Sefid, Sorkhabad and Veresk villages before arriving at Gaduk strait. Before reaching Orim Bridge, several tunnel-like galleries have been erected on the line in order to prevent damages from landslides and avalanches.



Picture 2.53: Orim viaduct.
Source: TIRRB archive.

Due to its unique geographical location, its ecologic conditions, proximity of sea and mountain, seasonal lakes as well as variety in vegetation and climate, the area through which the northern line goes enjoys a rich biodiversity so that many kinds of mountain, forest, plain and steppe animals live here. Moreover, various kinds of indigenous and migratory birds as well as aquatic plants and animals can be found producing interesting sights. Landscapes seen from Veresk and Se-khat-e-Tala bridges cover a wide range of forests, mountains and deserts serving as touristic attractions.

Picture 2.54: Se-khat-e-Tala viaduct.
Source: TIRRB archive.

After Gaduk Tunnel, the railroad extends near 80 km southwards with a mild slope along the Hablehrud valley before entering Garmsar (formerly known as Khavar) in the southern plain of Firuzkuh. Located at the northern edge of the Dasht-e Kavir, Garmsar has a dominantly desert climate.

Garmsar and the passage of the cross country railroad through the edge of the central salt desert of Iran (Dasht-e Kavir)

One of the peripheral cities of the central desert of Iran is Garmsar formerly known as Khavar. Covering an area of 97491 km^2 Semnan Province is the 7^{th} largest province of Iran. In ancient times, the Garmsar and Semnan region was part of the 14^{th} historical state of Veren (Verneh) out of the sixteen Avestan divisions. The geographical coordinates of Garmsar are: north latitude of: 34 degrees, 28-30 minutes and east longitude of 51-52 degrees, 52-55 minutes. Its location on the Silk Road as well as serving as crossroads connecting the east, west, north, and south of Iran had made Garmsar a key city of the northern half of the country during its long history.

Confluence of desert and mountain weathers affects the climate of the county. Natural caves, the Salt Lake and Kavir desert produce breathtaking views in the area. After Garmsar the line passes through 50 km of flat and barren lands at the northernmost edge of the great salt desert of Iran (Kavir). At Abardezh station, the line turns its direction towards the northwest and after going through the fertile plain of Varamin and Rey continues its path toward Tehran with a gentle slope upwards (Its gradient is 28:1000). Before reaching Tehran, the line traverses the central plateau of Iran containing both fertile and barren lands.

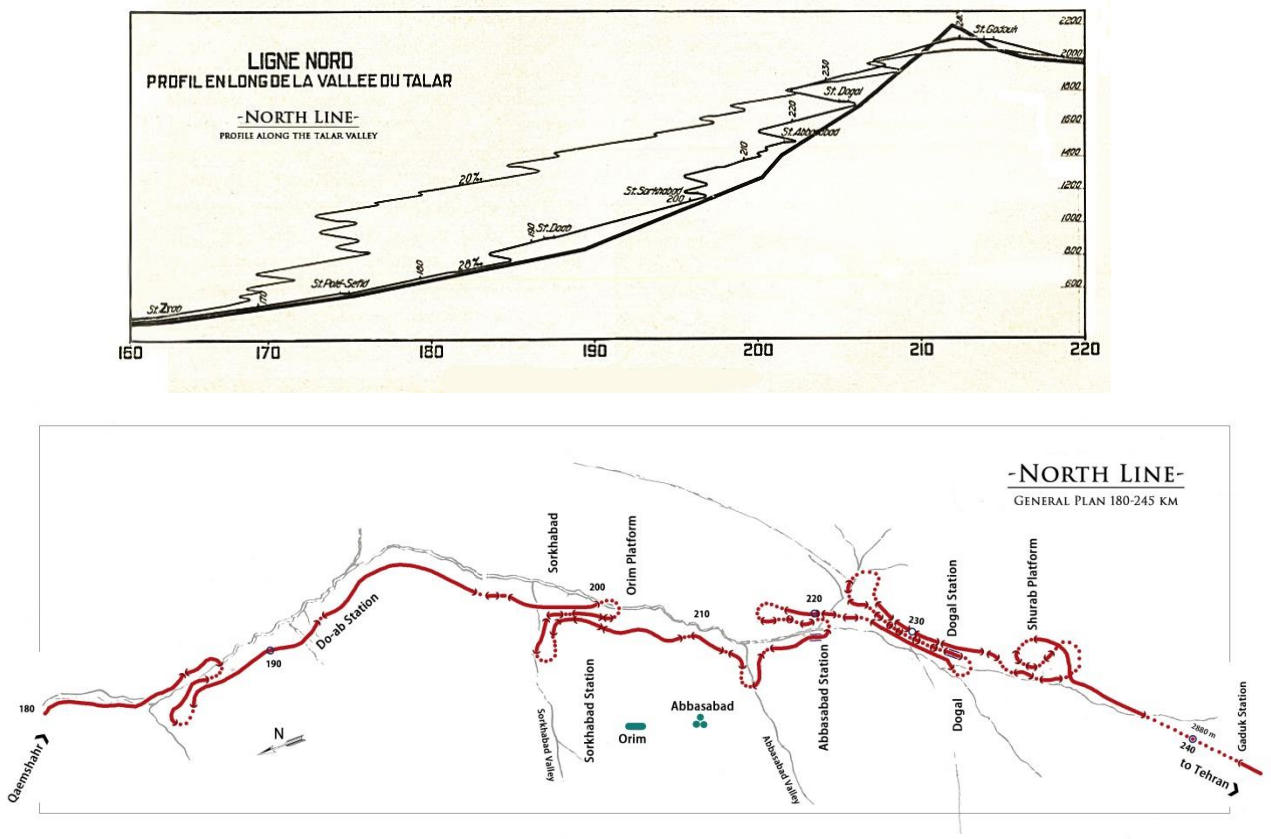


Figure 2.10: Lengthwise cross section of Talar Valley (Up); map of Zirab-Gaduk route (Down) (Mokammeli, 2000)**.**

Route	Stations	Construction	Operation	Length (km)
Tehran – Bandar-e Torkaman	Tehran- Rey – Bahram – Varamin – Pishva –Abardezh – Kavir - Garmsar – Bon-e kuh – Kabutar-Darreh – Simindasht – Zarrindasht – Mahabad – Firuzkuh- Gaduk-Dogal- Veresk – Sorkhabad-Savadkuh – Pol Sefid –Zirab-Shirgah- Qaemshahr- Gunibafi- Sari – Nobakht – Neka- Rostam Kola-Behshahr – Tirtash- Galugah – Bandar-e Gaz –Bandar-e Torkaman	1927	1937	461

Table 2.2: Stations of the northern zone.

Regarding the climatic conditions, the northern line runs through plain and mountainous regions. The highest point of the line is the Gaduk Strait which is 2112 meters above sea level. 187 km of the northern line passes by green plains and 113 km of it goes through forest highlands and into Gaduk and Firuzkuh straits. Here the juxtaposition of railway structures and virgin view of nature is regarded as a unique characteristic of the line. Passing through large bridges built over narrow valleys, the

northern line actually links cool mountains to hot deserts thus presenting a combination of unique cultural-natural attractions to viewers.

The most difficult part of the northern line is the section ascending the northern mountainside of Alborz in which the line enters the valley after traversing Mazandaran Plain and reaches Gaduk peak.

According to their contracts, German experts had 20:1000 gradients in mind but because of its inappropriateness for the location, the Ministry of Roads recommended that gradients of 25, 32 and 40 in one thousand should also be taken into consideration. On the path, a 135 km-long section with a 25:1000 grade, a 123 km-long section with a 32:1000 grade and a 113 km-long section with a 40:1000 grade already existed. On 1932, the line was analyzed in a session participated by minister of roads and head-engineers of northern and southern lines. As a result the attendants agreed on the 28:1000 grade and the construction of a 27/2887 m-long (Gaduk) tunnel was approved[2]. As a matter of fact, detailed researches by engineer Haklin led to this conclusion. In his report he writes:" given the fact that Talar Valley has several precipices which are occasionally impassable and the presence of a dense forest at its bottom, the Syndicate had to resort to the Stra-photogrammetric method to speed up the operations. This meant taking several pictures of lands from an airplane and preparing a detailed map by assembling them. As of 1931 and the dissolution of the Syndicate, the Ministry of Roads itself took charge of studying the northern slope with the assistance of Swedish engineers who settled on the 28:1000 grade. The Tachometry method was used for preparing relevant maps[3]."

As mentioned above, after the preparation of the map and its comparison with other regional maps drawn, the 28:1000 grade proposed by the Ministry of Roads was agreed and executed.

"Owing to the fact that the gradient selected was not sufficient to make possible ascending from Talar River to Gaduk Strait, it was necessary to extend the direct track artificially in order to reach the desired height. According to blueprints drawn by the Syndicate, the extra length could be provided by passing the line through subsidiary gorges of Talar resulting in the location of most of the line at the upper mountainside i.e. a precipice; this required the construction of several technical structures such as tunnels, valley bridges, retaining walls as well as long temporary side roads for delivering construction materials and instruments to the building sites which was very costly. Therefore due to the problematic nature of the Syndicate's proposal, the Ministry of Roads launched further detailed researches and finally settled on a plan which was cost-effective and not only paid due attention to the terrain type and existing usable mines but also considered the most suitable method of carrying construction materials to the building site. In the end it was decided to pass the line through the bottom of the valley which had a flat terrain. But approaching the strait, the valley became gradually steeper and at a specific point in which the river gradient overtook the maximum grade set for railway, the line could not be continued at the bottom of the valley. The specific point was near Taleh Village from which the line should be elongated artificially. Most of such increments were made in the form of spirals on mountainsides and sometimes around forked gorges of Talar Valley. Because the present dirt road which serves as the main delivery line for construction materials is located at the bottom of

[2] A Brief History of Railway" written by Anatoly Tersinski, page 85
[3] "The Trans-Iranian railway", the Harry Haklin report

the valley, in order to decrease expenses, it was necessary to increase the railway length so that it would not get very far or above the dirt road. Thus the extension was not concentrated on one location but was dispersed along the sides of the valley in small increments.

As said earlier, the artificial extensions were in the shape of spirals but occasionally adding snail and layered tunnels with rings in various forms were also considered but due to their higher cost, they were ruled out. After the selection of the spiral forms, artificial constructions were concentrated on the upper part of the mountainside which had a hard terrain made of granite. Therefore, the option of passing the line through dangerous forested mountainsides of the lower part was canceled. Because due to the swampy nature of the spot, the risk of landslides always existed. Additionally, in order to avoid problems caused by snowfall on open lines in highlands, the construction of a 2887 m-long tunnel at Gaduk Strait was planned. This was the longest tunnel on the whole cross country railroad of Iran. Although it was possible to reduce the height of the strait through which the line would pass, an increase in the length of the tunnel would have also become necessary. Another factor limiting the tunnel length was the time table set out for the finalization of the project in its entirety.

No major problem regarding the gradient was encountered and as planned the line would run along the Hablehrud valley in the distance between Firuzkuh and Garmsar. Given the fact that the river gradient never exceeds 18.5:1000, the line remains at the bottom of the valley for the entire distance.

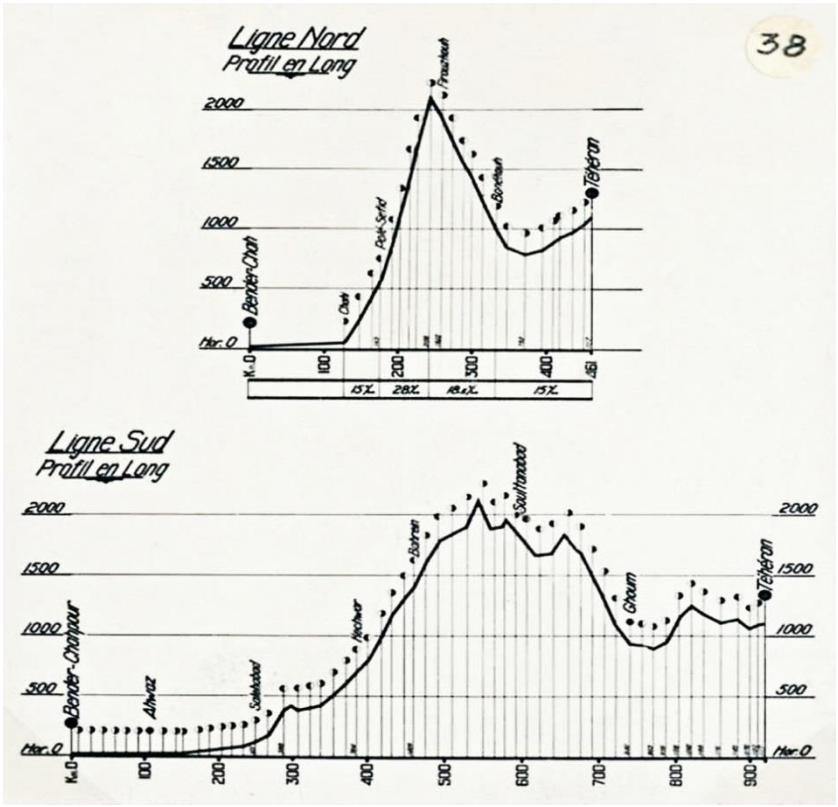
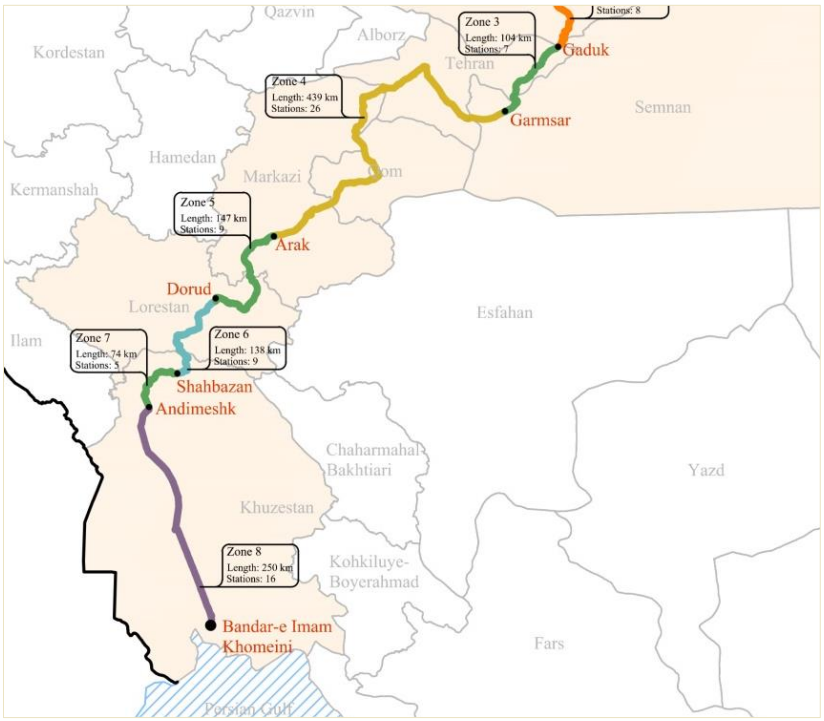


Figure 2.1: Lengthwise the Trans-Iranian railway from Bandar-e Imam Khomeini to Bandar-e Torkaman.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

2.a.5.2 The Southern Line (Bandar-e Imam Khomeini to Tehran)

The southern line covers the route between Bandar-e Imam Khomeini (former Bandar-e Shahpur) on the Caspian Sea as far as Tehran. The approximately 933-km line passes through Khuzestan, Lorestan, Markazi and Qom provinces before reaching Tehran. Beginning at Bandar-e Imam Khomeini the line traverses 250 km across the Khuzestan Plain before reaching Andimeshk. At a distance of 110 km from the port it passes through the large metal bridge of Karun (Pole-e Siah) in Ahwaz, the provincial capital.



Map 2.14: The Southern line (Imam Khomeini to Tehran).

Picture 2.55: Pol-e siah bridge – southern line.
Source: TIRRB archive.

Bandar-e Imam Khomeini is the southernmost tip of the Trans-Iranian railway located on a small bay about 80 km east of Arvand-rud which flows into the southwestern corner of the Persian Gulf. The port was considered as an ideal site for importing or exporting of goods by the railway and was expanding increasingly. An area covering about 1000 km^2 of coastal waters was studied and after measuring the water depth, a spot called Khor-musa was selected for harbor purposes because despite its relatively small width, it has optimum depth for ship docking. In contrast the lands surrounding the port are flat and swampy with tides as high as 6 meters.

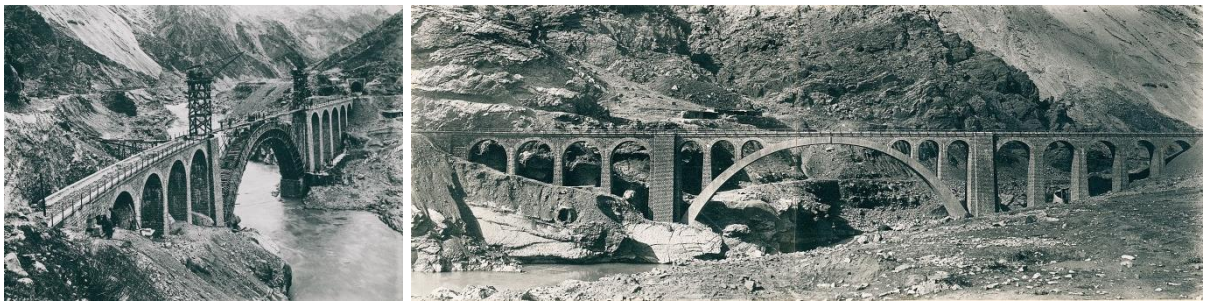
Leaving behind the Andimeshk Station located at a distance of 10 km west of Dezful, the line ascends along Balarud River course and enters rugged terrain. 290 km further on the line diverts into highlands which have deep floodways. The largest of these floodways are called Dam-dam and Shahbazan.

After traversing 323 km from its origin, the southern line reaches Shahbazan Station and runs along Abdiz and Absezar rivers 139 km further away. This section of the southern line was very hard to build because it had to cross 12 narrow valleys or straits sometimes with vertical sides requiring the construction of multiple technical structures such as 120 tunnels and nearly 20 small and large bridges. In-between Shahbazan Station and Tale-zang, ten tunnel spans measuring a total of 8058 m have been built. Moreover, well-known sites such as the waterfall of Tang-e Sezar are located in the vicinity of tunnel 12 which is one of the highest waterfalls of Iran. Also the lake of Dez dam and Salan-kuh Mountain with a height of 2650 m are situated in this area.

Lorestan: Lorestan province is about 31384 km^2 in west of Iran. The province is relatively elevated and Oshtran-kuh Mountain with a height of 4050 m is its highest peak. Lorestan has three different climates: cold and mountainous in north and northwest, temperate in its center and warm with low precipitation in the south. Due to its various climates and elevations, the province has dense and sparse forests.

Picture 2.56: Tang-e Panj – Talezang route (Photo by: Hossein Javadi)**.**

Tale-Zang formation in Lorestan has been named after Tale-Zang station. Several nomadic tribes living in Lorestan actually reside in the vicinity of the railway. They belong to Bakhtiari and Lorestani clans inhabiting Aligoodarz, Dorud and Khorram-abad counties. During their annual migration, they come as far as the Alvar-e Garmsiri district which is in Andimeshk County of Khuzestan Province. Sezar and Dez rivers constitute the natural, traditional and conventional border of the residential territory of nomadic tribes but most of time, they cross the rivers and by renting lands from other tribes spend the winter in these areas. Generally Bakhtiari tribes live on the eastern side and Lorestani tribes live on the western side of Lorestan railway.



Picture 2.57: Talezang viaduct.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

The autumn migration of these nomadic tribes from their winter to their summer quarters begins each year from the middle of Mehr. During their migration, the Bakhtiari tribes set out on foot or by car for Dorud, Qarun, Sepid-Dasht and Chamsangar stations (the last one serving as the main offloading site of nomadic tribes in these regions) and rent long-edged wagons for their livestock as well as roofed wagons for carrying their belongings. The tribes with small families also ride the local Andimeshk train for migration. Along the local railway line more than twenty nomadic and seasonal villages or black tents are seen each one with a train stop. Grazing and crossing of domesticated animals on railroads sometimes leads to train accidents with causalities. The local Andimeshk-Dorud train has a daily two-way service between these stations. The train has a capacity of up to ten passenger wagons and three long-edged roofed cargo wagons with a three-minute stop at each station.

Picture 2.58: Migration of nomadic tribes.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Left), TIRRB archive (Right).

Villagers living near the railway have to cross the line or go through train tunnels and bridges particularly school children. Some of the bridges are: the Tale-Zang station bridges as well as Keshvar, Ab-e Mamun and Cham-chid bridges. Besides, tunnels 25, 26 and 27 between Talezang and Tang-e Panj, tunnels 67 and 68 between Tang-e Haft and Keshvar and a few other tunnels are traversed by nomadic children regularly. Out of the 62 railway bridges built for the railway of Lorestan, 12 are large with the largest of them all being the 2098 m-long Ab-e Sezar Bridge located at 556 km from origin with seven 10-m, two 21.5-m and one 41-m spans.

The main access road beside the railway is the road built simultaneous with the line construction in 1933 in parallel to Bala-rud, Dez and Sezar rivers in the middle of Zagros Mountain valleys of Lorestan. It was built by surveyors and engineers of Kampsax Company with the aid of local workforce for mapping and supplying purposes.

Due to the location of the logistics dirt road called Kampsax road beyond the railway, nomadic tribes have to cross the line in order to reach the road. Of course it should be pointed out that domesticated animals only cross the railroad during migration time and only on the margins of Amir-abad and Cham-chid villages located near Cham-chid train bridge. Moreover, villagers and nomadic tribes residing at Gurkesh region inevitably go through the bridge with their belongings and livestock because they have no other choice. Furthermore, children living in Amir-abad village also commute to the rail roadside Cham-chid school via this bridge which has become vital in the regional transportation.

Picture 2.59: Absirom viaduct (Photo by: Hossein Javadi)**.**

Since the construction of the railway, the life of locals has been closely tied to it because many of villagers and nomads living in black tents were deployed for building and maintenance purposes as simple or office workers who eventually built their own homes in the vicinity of train stations thus virtually leaving their villages. Occasionally they even used railway construction materials to build their homes or black tents; for example sleepers which were easily available were used as wall covers, columns, shafts, pillars, ceiling/roof beams, benches, toys, parapets and roofing. Not only the railway had an impact on the life style of people but also affected their manner of migration and settlement. As a matter of fact after the railway construction, a steady flow of migrants began to settle in stations and years later moved to urban areas.

In Lorestan the railway passes through regions with rich natural resources and landscapes. The line linking Dorud and Qarun stations is 1402 m above sea level and has a height differential of 94 m at the section which also has 9 tunnels with a total length of more than 1700 m; among natural attractions of the route are: waterfalls, chestnut forests and the hanging tulips. In the summertime, nomads live in black tents and villages between Tang-e Panj and TaleZang. Dorud and Qarun stations serve as their offloading sites with the latter being the only local station in the area making possible the commuting of nearby villagers to Dorud and other places possible. Qarun and Bisheh stations stand 1306 and 1168 m above sea level respectively. Between these two stations, the line has a height differential of 134 m and 17 tunnels with a total length of more than 9350 m. the only twin railway tunnel of Iran called Namak stands after Cham-chid Bridge on this section. Also the highest peak of the region is Qarun Mountain with a height of 2543 m above sea level.

Picture 2.60: Dorud Station.
Source: TIRRB archive.

Further down Bisheh station is Sepid-Dasht station at a height of 1005 m above sea level. Between these two stations the height of the line decreases by 163 m as it runs through 10 bridges with a total length of 5232 m. Gazkuh mount with a height of about 1671 m is the tallest peak standing between these two stations. Moreover, there are several villages near the railway on the other side of Sezar River. The nomads live either in their villages or black tents and are engaged in animal husbandry.

At Doroud station located 20 km south of Brujerd, the line diverts east and after passing Azna turns north on an ascending route. A point located at a distance of 555 km from Bandar-e Imam Khomeini, near Nurabad station is the highest point on the Trans-Iranian railway with a height of 2217 m above sea level. Further away, the line turns northeast and descends at a mild slope into the Iranian plateau. From Arak as far as Qom, the line continues in parallel to the asphalt road and diverting north passes through Qare-chay and Rud-e shur rivers west of the salt lake and finishing the whole 933 km length of the southern line finally reaches Tehran.

Picture 2.61: Bisheh falls.

Picture 2.62: Sezar river (Photo by: Hossein Javadi)**.**

Specifying a certain route for the southern line was not as straightforward as the northern line. On the north line the will to traverse Firuzkuh and then Hablehrud and Talar valleys came out to be the decisive factor with only a few details remaining to be agree on. But on the southern line, before approving the final route between Andimeshk and Arak, two alternative routes were on the agenda; the first one between Dorud and Arak and the second one between Dam-dam River (at a distance of 313 km from the southernmost point of origin) and the meeting point of Ab-e Sezar and Ab-e Serom rivers (at a distance of 337 km from the southernmost point of origin). If the latter route had been selected the railway would have followed Dam-dam River upwards, then after crossing the highlands at a height of 930 m, would have descended towards the Ab-e Serom valley resulting a 15-km reduction in its length, although its lengthwise cross section would have created some problems for future utilizations. Additionally construction of two 7-km and 3.3-km long tunnels would have been necessary delaying the timetable originally envisaged for the project. The currently constructed line runs along Abdiz and Ab-e Sezar rivers and is better than the above-mentioned route despite being 15 km longer. It has optimal lengthwise cross section and a steady slope. For the section between Dorud and Tehran, several alternative lines had been studied including the following three lines proposed by the German-American syndicate:

1- Dorud-Brujerd-Malayer-Hamadan-Qazvin-Tehran

2- Dorud-Brujerd-Malayer-Saveh-Tehran

3- Dorud-Khomein-Qom-Tehran

"After the decision of the government to pass the Dorud-Tehran line through Arak and Qom, two other alternative routes were carefully studied. The first one followed Silakhord River and further away ran along the existing roadway and went through Brojerd and Malayer cities. But the second line headed eastwards at a more or less straight line after leaving Dorud behind; and passing through Darband[4] and Azna cities diverted to north. Further on the line left behind the Nurabad peak and with a gentle slope descends towards Arak via Astaneh and Shazand. The second line which is about 70 km shorter than the first line was approved by the government[5]."

Picture 2.63: The cross country railroad in Bandar-e Imam Khomeini dock as its southernmost port.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

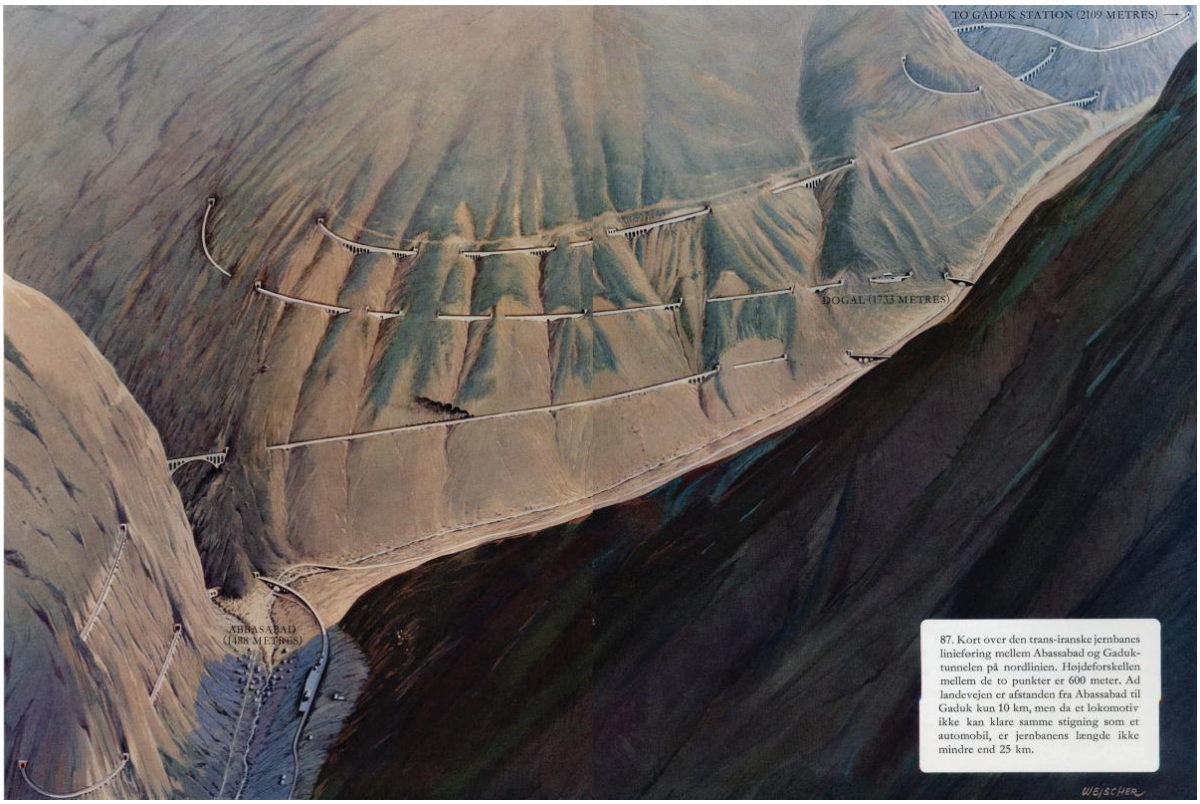
[4] On Peshtar mountainside

[5] "The Trans-Iranian Railway", the Harry Haklin report; pp. 58-65

Picture 2.64: Construction of Bandar-e Imam Khomeini station.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

2.a.6 Engineering Structures of the Cross Country Railroad (a structural and technical review)

Throughout the world, the structural and technical aspects of railways highly depend on natural characteristics and topographic features of the route. Railway construction of lines passing through flat or mildly-sloped terrains (such as plains) is quite different from those heading into rugged terrains (like mountainous areas with deep gorges). Here a brief review of the route for the Trans-Iranian railway comes followed by a discussion about the structural and technical operations on lines and buildings along the route. It is clear that explaining the line characteristics should not be limited to the line structure but facilities and buildings related to temporary roads, tunnels, bridges, stations, technical structures, residential buildings as well as foundations and superstructures must also be taken into consideration. Reexamination of these facilities is difficult due to the passage of time and renovations conducted making necessary a glance at reports submitted by engineers and experts in charge of the construction or supervision of various sections of the Trans-Iranian railway in particular reports prepared to be registered in history. For example, about mapping of different routes as well as tunnel construction, reports of engineer Harry Haklin have been referred to, on the subject of foundations and superstructures reports of engineer Parviz Bahman[6] and regarding bridges and technical structures reports of H. Nutter, a bridge-building specialist have been used.


TO GADUK STATION (2109 METRES) →
DOGAL (1733 METRES)
ABBASABAD
(1438 METRES)
87. Kort over den trans-iranske jernbanes linieføring mellem Abassabad og Gaduk-tunnelen på nordlinien. Højdeforskellen mellem de to punkter er 600 meter. Ad landevejen er afstanden fra Abassabad til Gaduk kun 10 km, men da et lokomotiv ikke kan klare samme stigning som et automobil, er jernbanens længde ikke mindre end 25 km.
WEISCHER

Picture 2.65: Gaduk – Veresk route.
Source: TIRRB Archive.

[6] The first general manager of the state railways of Iran (1935-36)

2.a.6.1 Construction Operations superstructure & infrastructure (superstructure & infrastructure preparing and track-laying for the Trans-Iranian Railway)

Railways usually bring to mind two parallel metal lines fastened to the ground but track-laying is actually a sophisticated activity. Its main materials are tracks, sleepers and connecting parts which must be compatible with the train traffic and relevant pressures. Sub-base preparation operations on the other hand depend on the natural conditions of the regions but must be in proportion to track-laying. Throughout the cross-country line, major consolidation activities have been done and if required bridges, retaining walls, technical structures, floodways, channels, heavy walls, etc…have been built in order to protect the rail from various dangers. Sub-base preparation infrastructure activities in various sections of the cross country railroad have been as follows:

1- Part of the Bandar-e Torkaman to Qaemshahr route extending 127 km into the Mazandaran plain. Its longitudinal cross section shows a maximum gradient of 7:1000 because the line has generally been backfilled. Also on the southern line, the 250-km distance between Bandar-e Imam Khomeini and Andimeshk extending in the plain has been backfilled. Its maximum grade is 5:1000 and the minimum arc radius is 500 meters.
2- Most of the Bon-e kuh - Tehran and Tehran - Dorud route required extensive backfilling but proportionally less earth-moving. It has a variable gradient of 7-15:1000 with an arc radius of:

A) 300 m for: Dorud to Darband (27 km), Dareh-dasht to Tehran (429 km) on the southern section and Qaemshahr to Shirgah (21 km), Bon-e kuh to Tehran (129 km) on the northern line
B) 250 m for: Mazu to Chamsangar (91 km), Sepid-dasht to Dorud (41 km), Darband to Dareh-dasht (11 km) on the southern line and Shirgah to Pol Sefid (27 km) on the northern section.
C) 220 m for: Andimeshk to Mazu (58 km) and Chamsangar to Sepid-dasht (18 km), both on the southern section

3- The Pol Sefid to Bon-e kuh and the Dorud to Shahbazan routes on the northern and southern lines respectively headed into impassable areas which required extensive mountain-cuttings and construction of long tunnels. The rugged terrain has resulted in building small and large bridges within short distances. The 73 km-long Firuzkuh to Bon-e kuh route has a maximum gradient of 18.5:1000 and a minimum arc radius of 250 m.
4- The steep 84 km-long Pol Sefid to Firuzkuh route has a maximum gradient of 28:1000 and a minimum arc radius of 120 m.

Picture 2.66: Sample of infrastructure and superstructure of the line.
Source: TIRRB Archive.

As mentioned before, the northern line is 461 km and the southern line is 933 km; railways traversing plains in the southern and northern parts are 250 and 127 km respectively constituting almost 27% of each line. The figure shows that about 73% of the Trans-Iranian railway passes through mountainous areas. Construction of the Tehran to Bandar-e Torkaman line was quite problematic. According to its cross section, it has steep slopes and arcs with short radii. The backfilling width of the route was 5.4 m and the entire backfilling and earth-moving activities have been carried out manually or with double-coiled coachs wagons. The height of the backfill was adjusted so that its consolidation was preserved after subsidence. A total of 28.000.000 cubic meters of backfilling and earth moving has been done on the Trans-Iranian railway. During the construction phase, occasional extensive landslides occurred and a change of courses, line corrections or construction of open tunnels or drainage canals became necessary.

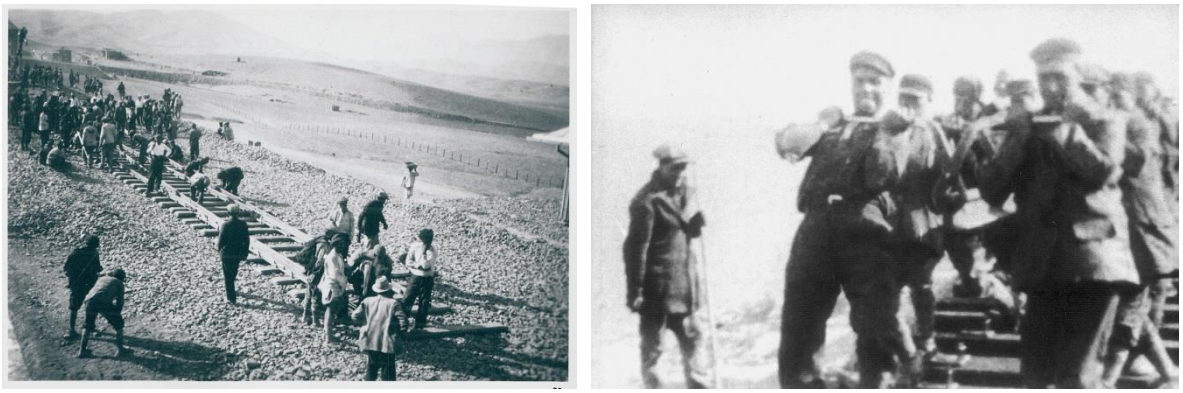
Picture 2.67: Foundation-laying for Trans-Iranian railway.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Gravel-spreading: gravel was taken from riverbeds or 6-cm stones were used or larger stones were broken. At some points, it turned out to be very costly for example all the gravel used on the 250-km

long Bandar-e Imam Khomeini to Andimeshk route was taken from a pit near Andimeshk using various vehicles including trains. The high quality gravel was used at a width of 3.2 m with a maximum diameter of 40 cm.

Sleepers: both wooden and metal sleepers have been used in the cross country railroad. On the 1394 km-long railway about 980 km wooden and 414 km metal sleepers were laid. On the northern line in154 km (between points located at 193 and 347 km from origin) and on the southern line in 210 km (between points located at 300 and 510 km from origin) of the route, metal sleepers have been installed. Each of the 2.4 m long Krupp sleepers weighed 60.8 km. Also in 1929, some light-weighted sleepers were bought from Krupp Company and laid at the 50-km long route between Behshehr and Bandar-e Gaz. But the majority of sleepers on the Trans-Iranian railway is made of wood supplied by Shirgah factory from Mazandaran forests. The oblong cube-shaped sleepers were coated with special oil and had a length of 2.60 m, a width of 24 cm and a diameter of 15 cm but in the nearly 300-km distance between Bandar-e Imam Khomeini and Andimeshk, the wooden sleepers are made of wood coming from Australia.

Rails: at the beginning of railway construction, some light-weight rail was purchased. Each part of the rails weighted 33.480 kg per meter and was 12 m in length. Despite the fact that the entire length had not yet been fully studied at the time, it was installed between Bandar-e Torkaman and Shirgah. Later due to technical considerations as well as the longitudinal section/cross-section study of the line, it was decided not to use rails lighter than 36 kg; at last Russian rail was bought with a weight of 38.614 kg per meter at a more affordable price.



Picture 2.68: Track-laying.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Rail components: eclisses[7] have four or six holes and are used for strengthening the rails at sloped or winding routes. These metal discs are installed high on the cross section of rails and are fastened to sleepers with three nuts for more consolidation.

[7] Eclisse or rail clamp

Track-laying: in 1929, the German-American Syndicate laid rails on 127 km of the northern line from Bandar-e Torkaman as far as Qaemshahr as well as 250 km of the southern line from Bandar-e Imam Khomeini to Andimeshk. Later they also laid tracks on another 50 km further north from Andimeshk by subcontracting. But the rest of the line was finished by the Kampsax Consortium on consignment. From a total of 1394 km of rail-laying, 852 km belonged to the northern and 542 km to the southern sections of the Trans-Iranian railway. As planned the two sections met at Sefid Cheshmeh Station (formerly known as Fuzieh[8]) at a distance of 542-550 km from Bandar-e Imam Khomeini. The monthly rate of rail-laying on the southern and northern lines were: 25 and 23 km respectively. On each kilometer of the route, 1280-1440 wooden sleepers and 1360-1520 metal sleepers were installed.

Picture 2.69: Track-laying.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Back-filling

An earth fill is consisted of: the backfilled layer, the subgrade and the sub-ballast, each requiring different materials and density. Sequence of operations on the Trans-Iranian railway was: first earth moving in order to take away soils or stones or other materials such as loose earth resulted from landslide or trench slipping/falling. Then came the backfilling stage in which a mixture of stone and earth materials were used for subflooring, rock-filling and buttressing of walls or technical structures. Rock-fills are grouped into three categories: load-bearing, filling and consolidating.

Sometimes fences were used for protecting gabled backfills by nailing at 60-cm intervals with willow branches filling hedging in the space between nails. Occasionally willows, white mulberries or other trees were planted in backfills for protecting them against the effects of water.

[8] After the Islamic revolution its name was turned to Somayyeh.

Track-laying of the Trans-Iranian Railway

At the time, three types of track-laying were prevalent in the world: light, medium and heavy.

Light: in which the maximum weight of each standard meter of rail was 30 kg and each 12-m long segment of rail was mounted on 14 sleepers.

Medium: in which the weight of each standard meter of rail equaled 38 kg and each 12.5 m-long segment of rail was mounted on 17 sleepers on straight routes and 19 sleepers on bends. Of course this type of track-laying can only stand locomotive loads not more than 15 tons on each motion axis. This type of track-laying was used in the Trans-Iranian railway and can tolerate a maximum locomotive load of 15 tons on each motion axis.

Heavy: in which the weight of each standard meter of rail equaled 45 kg and each 12-m long segment of rail was mounted on 21 sleepers. This type of track-laying can bear locomotive loads up to 18 tons on each motion axis.

Rails used in the Trans-Iranian railways are of two kinds:

1- The 12-m long rails mounted on 17 sleepers with a weight of 33 kg for each standard meter
2- The 12.5-m long rails installed upon 17 or 19 sleepers on straight lines or bends respectively with a weight of 38 kg for each standard meter

Railway Line Gradient

Generally four types of gradients are seen in the Trans-Iranian railway:

1- Low gradient of 0-7:1000 with a minimum arc radius of 500 m in the following routes: the 127 km-long Bandar-e Torkaman to Qaemshahr line in the north and the 250-km-long Bandar-e Imam Khomeini to Andimeshk line in the south
2- Medium gradient of 7-15:1000 in the following routes:
   A. Rail turning with the radius of 300 meter are located in:

Dorud – Darband	27 km in south
DareDasht – Tehran	429 km in south
Qaemshahr – Shirgah	21 km in north
Bon-e kuh – Tehran	129 km in north

   B. Rail turning with the radius of 250 meter are located in:

Mazu - Chamsangar	91 km in south
Sepid-Dasht – Dorud	41 km in south
Darband – DareDasht	11 km in south
Shirgah – Pol Sefid	27 km in south

   C. Rail turning with the radius of 220 meter are located in:

Andimeshk – Mazu	58 km in south
Chamsangar – Sepid-Dasht	18 km in south
Firuzkuh – Bon-e kuh	73 km in north
Pol Sefid – Firuzkuh	84 km in north

3- Steep slopes of 15-18.5:1000 and a minimum radius of 250 meter are located in:
Firuzkuh – Bon-e Kuh 73 km in north

4- Very steep slopes of maximum 28:1000 and a minimum radius of 220 m on bends in the following route:
Pol Sefid – Firuzkuh 84 km in north

Protective Walls

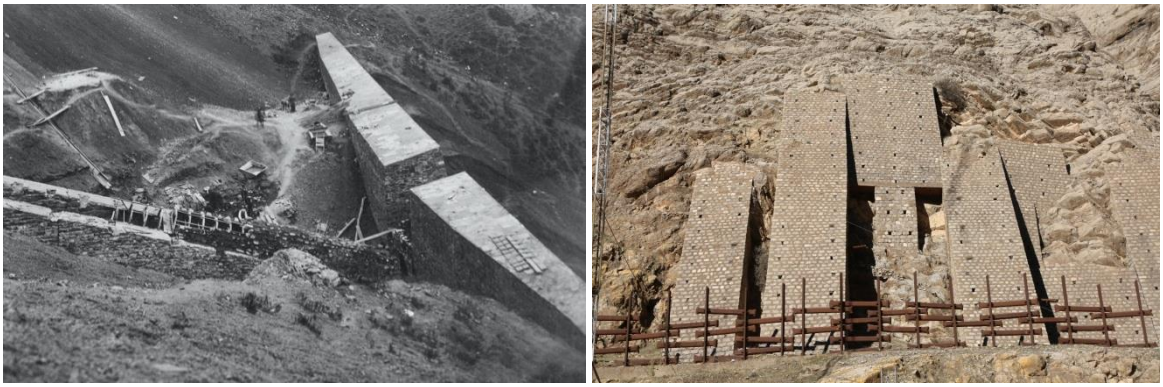
Several protection methods have been used in order to safeguard the railway against landslides and/or subsidence; among them is the construction of protective walls which have several types as follows:

Retaining Walls: are built at the foot of backfills preventing them from slippage. For lower levels the weighted type, for medium levels the reinforced-concrete type and for heights more than 7m the counterfort type wall is erected which has a triangular support. Usually wall dimensions are measured using fild charts. Within the walls, sloped conduits called Barbikan were installed to prevent the wall from overturning and to drain the water penetrated into wall backs. Also behind the walls, cobblestones were laid which worked as filters in order to prevent the obstruction of barbicans. On long and integrated walls, seams called exequation joint were set on walls to prevent cracking caused by contraction and expansion. (The gap between two junes is called kampa.) On the other hand at places requiring mountain cutting or tunnel construction in order to go through mountainous areas, depending on the railway project level, retaining walls were built in front of trenches in order to prevent them from collapsing. Trenches were partitions on both sides of the route resulting from mountain cutting. Dimensions of the retaining walls were less than safety walls.

Picture 2.70: Constructing process of a covering wall.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.71: Covering wall.
Source: TIRRB Archive.

Picture 2.72: Retaining Walls.
Source: TIRRB Archive.



Picture 20.73: Retaining wall.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Left), TIRRB Archive (Right) .

Picture 2.74: Constructing process of retaining wall.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.75: Retaining wall (Hossein Javadi)**.**

Return Walls: were used at spots where safety walls could not be erected because of very steep side slopes or at bridges with strong water currents. In these cases they were used in front of walls same as the conical quarter walls or at the foot of back fills beside the bridge.

Cover Walls: are used for covering trenches suffering from superficial weathering. Pressure on these walls are insignificant therefore they were made thicker at a height of 80 cm or more.

Coastal Walls and: are kinds of walls built on riverbanks in order to direct water toward the bridge span and preventing from inundation during river flooding. Usually they were built at coastal crest lines. In cases of an arced-shape wall as the water current hits hard against the wall, construction of flood walls at an acute angle relative to the coastal wall is required. These types of walls were also built in order to prevent the washing up of embankments.

Dam Walls: at spots where the river water flowed into the bridge span at a steep slope, these walls were built at the upstream of the river. After falling from the dam wall, the water loses most of its energy and enters the bridge span at a milder slope so that no damage can be inflicted.

Drainage Canals: are a subset of Trans-Iranian buildings used in tunnel construction. These canals divert the flow of subterranean and surface waters aimed at the prevention of any potential damage to railway lines and structures. Functionally, they are grouped into three divisions: canals directing and discharging surface waters, canals lowering the level of underground waters and canals discharging waters from the back or floor of buildings (Barbikans). In addition to the construction of facilities which direct water through tunnels, tunnel floors were sloped towards the water discharge canal with a lid made of reinforced cement and the gradient of the canal itself was oriented towards the tunnel mouth in order to empty the penetrated waters from the tunnel. When a strong backfill for the tunneled railway line exists, tunnels are built without raft and vice versa.

Picture 2.76: Zirab – Shirgah route and drainage canal.
Source: TIRRB Archive.

The technique of drainage is consisted of discharging and diverting waters that weaken or damage technical and protective structures. Drainage is frequently used in the Trans-Iranian railway and has the following types:

Short drainage: is used at spots with a flat ground but a high embankment so that engineers had to direct rainwater from one side to the other side of the embankment.

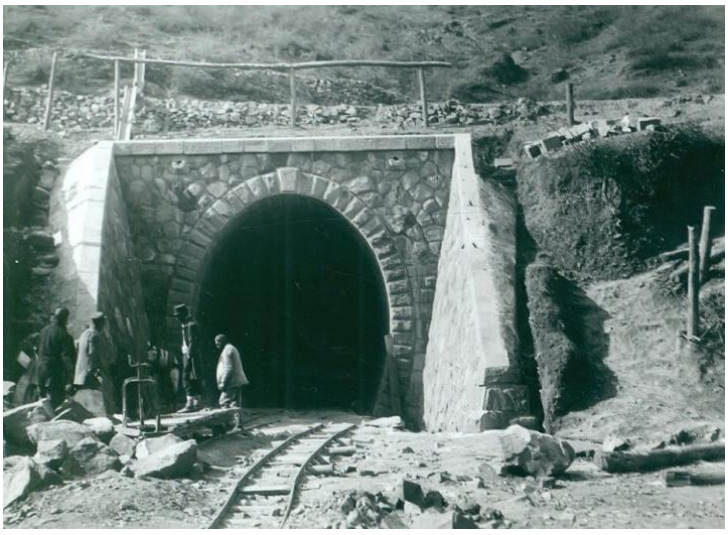
Gallery (deep drainage): occasionally the trench or the embankment is threatened by underground waters leading to their dislocation or subsidence without knowing the exact place of the accumulated water. In order to find it out, wet parts of the ground are dug as far as the water source. This kind of drainage is called gallery. Moreover, drainage pipe was used for preventing the collapse of the ceiling or parapets of the gallery. Sometimes branch galleries were set up because of expansive water distribution.

Barbikan: as mentioned earlier, protective walls and bridge or tunnel parapets were perforated for directing water away from behind the wall. These orifices were called Barbikan.

Diversion Canals: were dug at earth-moving spots or canals and in parallel with railway lines in order to gather and divert water from the railway body. These canals were made of earth, stone or cement. Engineers working for the Trans-Iranian railway installed drainages within the deck of large bridges so that the water gathered on the deck could be directed into a metal pipe with an optimal gradient topped by a cobblestone. The result is similar to drainage.

2.a.6.2 Tunnels

The Trans-Iranian railway not only linked northern and southern waters of Iran but also connected well-populated places to villages with various climates. But to begin with, Zagros mountain chain in the west and Alborz mountain range in the north had to be passed through requiring the digging of several tunnels. Geological strata of mountains standing in the path were different causing problems due to various techniques needed for tunneling.



Picture 2.77: Constructing process of tunnel – Savadkuh to Pol Sefid route.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Out of the 224 tunnels built on the Trans-Iranian railway, 93 are located on the northern line from Qaemshahr to Tehran with a total length of 23599 m and 131 tunnels are situated on the southern line with a total length of 60067 m giving a sum total of 83666 meters. The length of tunnels constitute 6% of the entire length of the Trans-Iranian railway. On the whole, 3300000 cubic meters of earth removal has been done and one million m^3 of cement has been used for inner coating of tunnels. During the construction of tunnels, 2800 tons of dynamite, 17000 tons of cement and 334 tons of special gunpowder for exploding mountains have been consumed. Gaduk tunnel with a length of 2880 m on the north section is the longest tunnel on the Trans-Iranian railway and the 2526-m long tunnel at Tang-e Chahar-e Abdiz is the longest tunnel on the southern line.On the northern line, four tunnels are more than 1 km in length and 9 tunnels are 0.5-1 km long.On the southern line, four tunnels are more than 2 km in length, 17 tunnels are between 1 to 2 km in length and 16 tunnels are 0.5-1 km long.

Due to heavy rainfall and high humidity of the air on the coastal area of the Caspian Sea, Alborz mountainside is fragile and underground water tables are abundant resulting in great difficulties for tunneling including cave-ins. To prevent these problems, more attention was paid to the consolidation of tunnel ceilings and pillars by lining and lining with stone and cement. A lot of piping and draining was done to divert water direction but after the tunnel construction, they had to be removed. Furthermore, in order to avoid any potential damage caused by strong quakes, consolidation of tunnels was given priority so that on occasions, up to two meter-thick of inner coatings were applied.

But on the other hand, the southern parts of Iran are very dry and the high Zagros Mountains stand formidably against excavation making it quite difficult. In contrast not much consolidation activity was needed and due to a lack of water within tunnels not much draining and partitioning was needed here but the hard fabric of rocks made the consumption of a huge amount of dynamite and gunpowder necessary as well as the usage of modern machinery for tunneling.

Picture 2.78: Constructing process of tunnel.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Generally on the northern line, tunneling required hard labor, huge expenses and usage of modern technology of the time because of the technical problems encountered including strong pressures on schist strata. As a matter of fact, water penetration increases the volume of these layers making then swell. As a result not only firm wooden scaffolds collapse under pressure but also the resistance of covers made of construction materials crushes. Especially the worst schist strata existed at Gaduk tunnel and tunnels #15, 16, 21, 23 & 26 on the northern line. In Gaduk, solid load-bearing poles crushed under such pressure; they were made of wood measuring 30 by 30 cm. Also galleries measuring 1.80 by 2.20 m collapsed. Therefore it was necessary to carry out a full technical study beforehand on the projected size of tunnels and the thickness of their coatings in order to guarantee necessary resistance. Sometimes the diameter of the roof over some parts reached as high as 60 cm or even 1.20 m. Another risk factor for tunneling was water penetration; the worst accident happened during the construction of Gaduk tunnel in the summer of 1933 when a source of underground water was encountered and following some excavations flooding occurred at a rate of about 120 liters per second so that the frontal part of the tunnel was totally submerged. Fortunately the water was quickly discharged but a few months later another water source appeared at the same tunnel albeit with a slower speed of current. Also in other tunnels springs flowed such as the two springs of tunnel # 52 of which one was hot spring. Another major water spring appeared at tunnel # 54. Yet another matter of concern for technical workers was harmful gases rising from the heart of mountains especially on the northern line, the methane gas jeopardized tunneling; as an example it caused such huge explosions at tunnel # 36 that extinguishing the blue-colored flames took about one month. In that case workers had to tolerate temperatures above 55 degrees centigrade making the usage of electrical fans unavoidable. Existence of salt mines in southern tunnels not only complicated the work but also increased expenses because salt crusts dissolved in moisture and fell off the inner surface of tunnels making the application of a cement cover necessary.

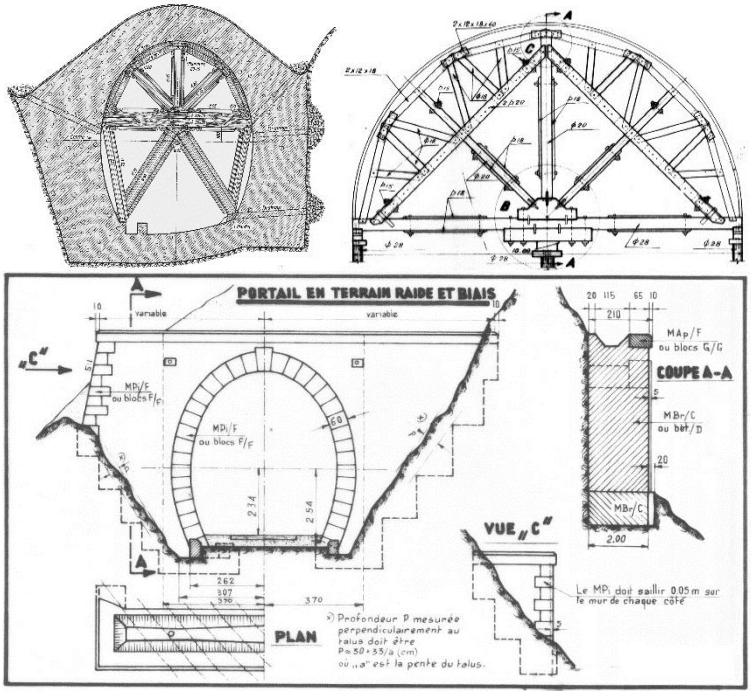


Figure 2.2: A tunnel's Sections

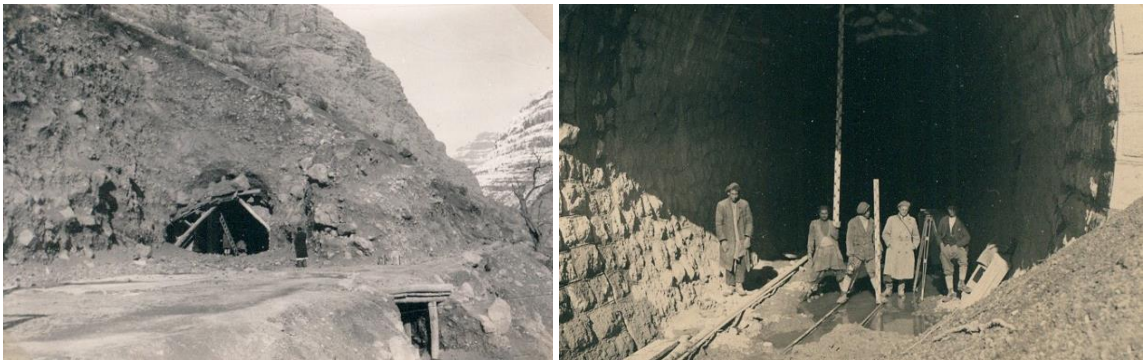
Dimensions of Tunnels

From a structural point of view, tunnels of the Trans-Iranian railway are of three types:

A) Straight and arch tunnels with an arc radius of above 250 m, a width of 5.20 m (from the tip of their vault) and a height of 5.80 m (from the gravel-spread surface).
B) Arch tunnels with an arc radius of 250 m or less, a width of 5.50 m and a height of 5.80 m.
C) Tunnels with a width of 5.80 m and a height of 6.00 m

The C type is only seen at the tunnel of the Gaduk peak from its northern mouth as far as the middle of the tunnel for a better ventilation. Tunnels have been built in an elliptical shape in order to resist potential underground forces; also tunnel walls and piers are slightly crescent-shaped. In case of any pressure at the bottom part, the tunnel floor has also been built like an inverted vault. The internal coating of tunnels have been executed in the form of consecutive loops 3 to 6 m in length depending on the terrain type. 2-4 cm-long seams have been inserted between loops with a 3-cm deep pointing.

Another important issue in tunneling is to specify the meeting point of vertical and lateral excavations which in case of grave errors, will render the tunnel useless. But such errors have been insignificant in the process of tunneling for the Trans-Iranian railway showing precise calculations and standard methods of execution. As an example in the nearly 3 km-long Gaduk tunnel, the lateral and vertical errors were only 16 and 20 mm respectively which is surprisingly low thanks to the correct mapping performed with trigonometrically precise measurements before any digging activity.

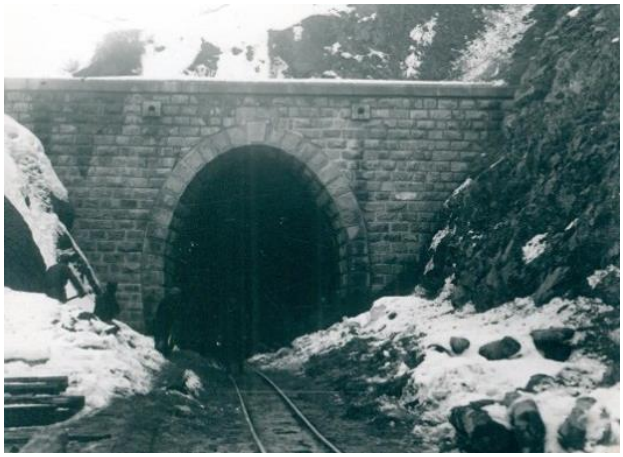


Picture 2.79: Tunnel excavation.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Major Tunnels of the Trans-Iranian Railway

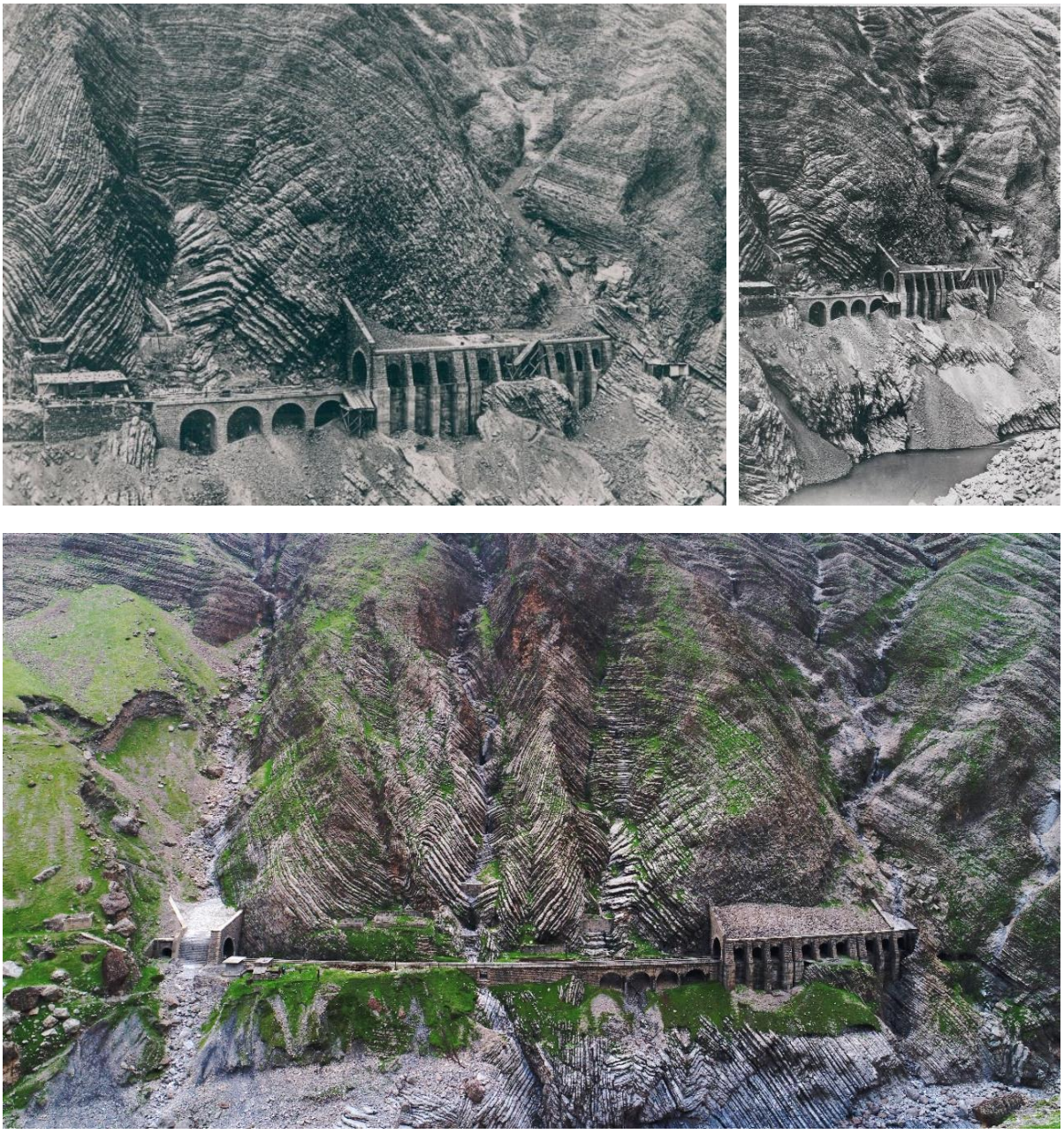
Gaduk: most of the tunnels of the Trans-Iranian railway are on the northern line. The inner side of them has been covered with a layer of stone or concrete but at spots with loose soil, reinforced concrete has been applied too. As a matter of fact, the 2887.27 m-long Gaduk was the eleventh long train tunnel of the world at the time. On the northern line, four tunnels exceed one kilometer in length and nine tunnels are longer than half a kilometer. Gaduk the eleventh long train tunnel of the world at the time. Gaduk Tunnel has been built at a 0.028 grade in the otherwise impassable mountainous regions of Gaduk and Veresk. With a length of 2887 m and a width of 5.60 m, Gaduk is not only the

longest but also the widest tunnel on the Trans-Iranian railway. Also about 900 meters of its southern end is actually situated at the highest elevation compared with other train tunnels of Iran.



Picture 2.80: Photo of Gaduk in the past.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.81: North line tunnels.
Source: TIRRB Archive.

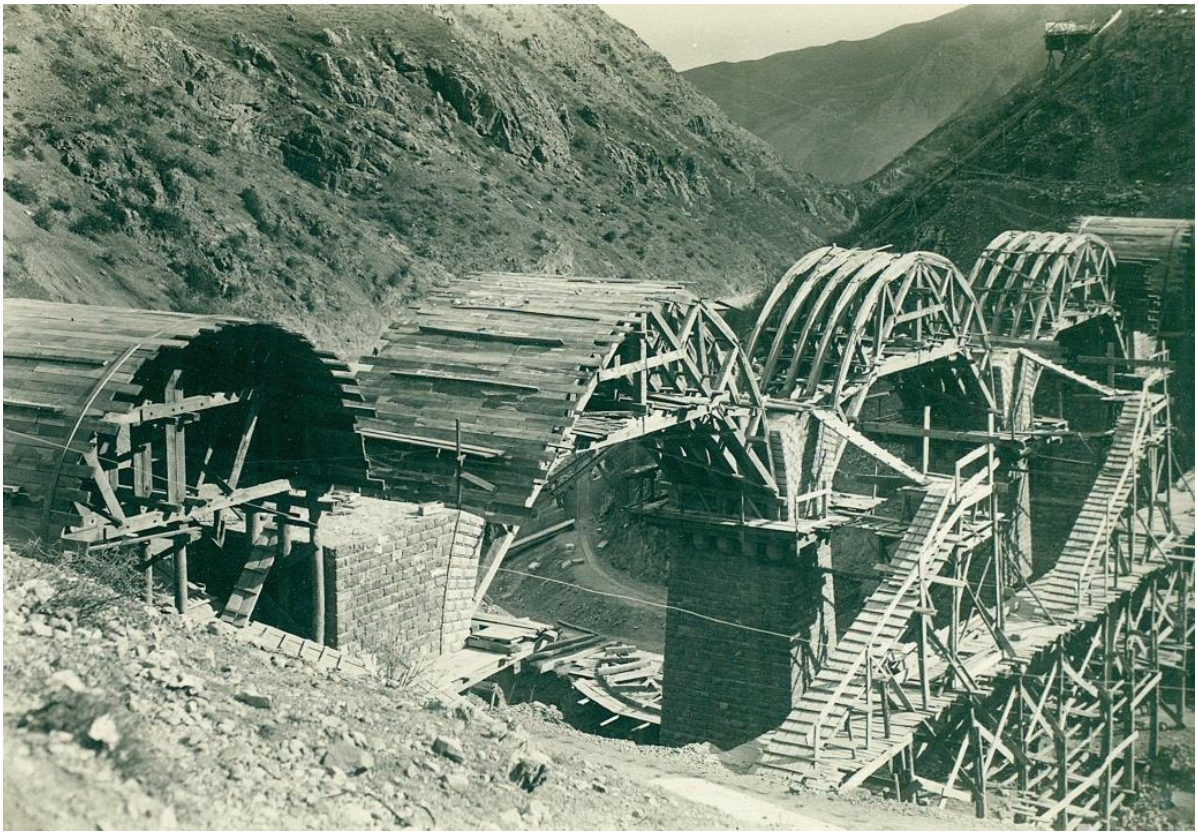


Picture 2.82: Gallary and bridge in Lorestan district.

Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Up), (Photo by: Atefeh Momen (Down)).

2.a.6.3 Bridges

Although bridge construction is regarded as an essential operation in railways, its importance is less than tunneling. According to the technical characteristics register of Germany, resistance of bridges is calculated for a train weighing twenty tons on each axis.

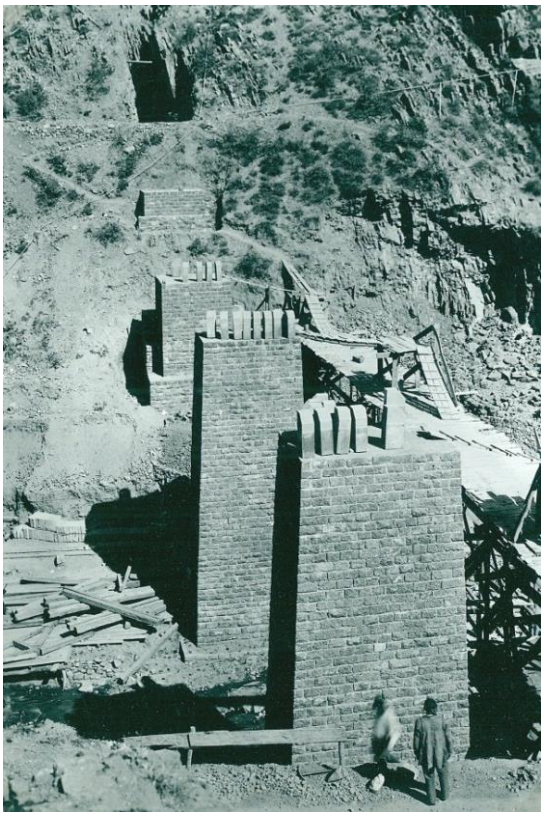


Picture 2.83: Constructing process of viaduct – North line.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.84: Dom Dom viaduct (Photo by: Atefe Momen).

So the following principles have been applied in formulating plans:

A) Maintaining the existing waterway; so in order to avoid the possible change of natural watercourse, bridge pillars were not installed within currents and if possible the width of bridge spans have not been decreased much because consequences of changing the water course cannot be anticipated.
B) Respecting safety precautions in building construction
C) Construction work at the least possible cost while observing principles A and B



Picture 2.85: Constructing process of viaduct's piers.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Prior to plan formulation, necessary studies were conducted in order to discover usable quarries along the railway line. Afterwards, samples of them were sent to the laboratory in order to assess their resistance to frosts, pressure and water infiltration. Lab results were mostly negative requiring the turning of stone structures into concrete ones. Despite this, constructions with available materials were given priority so as to reduce the need for importation. Reinforced concrete was used only in waterways with a width of 8 m and a height too low to install a vault on the waterway. Only in cases which had a narrow bridge span, a height too low to install a vault or a ground too weak to tolerate the weight of the bridge, metal structures such as: large or small bridges and tubes were used. In structures with a foundation laid in water, the effects of water on the structure were paid special attention. As a matter of fact, water in particular sulphurous water gradually penetrates into iron, concrete and mortars harming the structure. For preventing the detrimental effects of water on mortars and concrete, usage of Sica-1 was inevitable moreover Armco and Tonekabon iron were used in iron structures. Concrete for heavy structures was exclusively Portland cement which was partially made in Iran but largely was

imported from Yugoslavia, Russia, Japan, Belgium, Denmark, Sweden and Norway. Wood was merely used in temporary structures like temporary road bridges, vault frames etc…

Bridges on the Trans-Iranian railway are:
1- 47 large masonry bridges with 82 main spans
2- 107 valley bridges in which masonry has been used with 452 main spans
3- 20 large metal bridges with 115 main spans
4- 186 small metal bridges with 634 main spans
5- 1368 vaulted waterways 14465 m in length
6- 1475 bridges with reinforced concrete coating and 1951 main spans
7- 421 metal tubes 4100 m in length
8- 476 reinforced concrete pipes 7123 m in length
9- Six overpasses
10- One underpass

Various Types of Bridge on the Trans-Iranian Railway

A variety of bridges have been built on the Trans-Iranian railway:

River bridges: such as Saleh-hamid and Dom-dom bridges on the southern axis are built over rivers and their bridge span is directly proportional to the river width and water volume

Waterway bridges: are built at the thalweg of lands surrounding the railway so that rainwater and farming irrigation water can pass below them

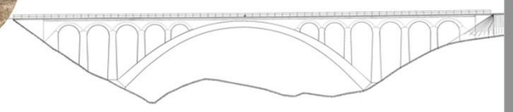
Valley bridges (duke or V.D): are usually long and are built over valleys in order to offset the effects of level difference such as: Veresk bridges.

Picture 2.86: Constructing process of a bridge.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

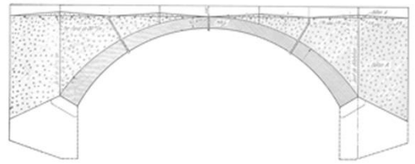
Bridge Types of the Trans-Iranian Railway based on Appearance and Structure

The folloing figure shows typology of bridges on trans-Iranian Railway.

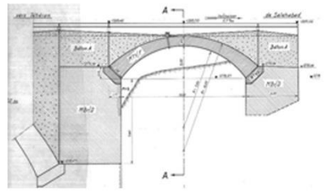
Type 1:
Bridge type: One-span arch
Number: 3236
Frequency percentage: %11.5



1.A.
Symbol: VIADOC
Bridge type title: Viadoc
Bridge type: Valley vault
Define bridge type: High Bridge vaulted railway on the valley

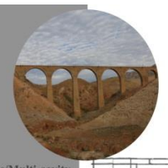


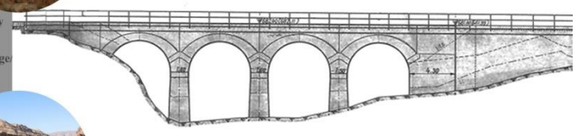
1.B.
Symbol: AV
Bridge type title: Aqueducvoute
Bridge type: Arch of a rock crater
Define bridge type: One stone rock bridge



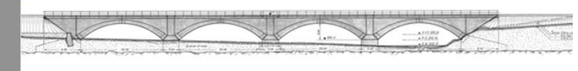
1.C.
Symbol: AVs
Bridge type title: AqueducVouteSurbaisses
Bridge type: Smooth spine
Define bridge type: Single-span bridges, either concrete or rocky with low arc height

Type 2:
Bridge type: Multi-span arch
Number: 195
Frequency percentage: %0.7



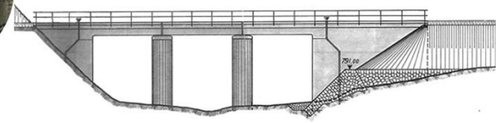


2.A.
Symbol: PV
Bridge type title: Poly Voute
Bridge type: A few stone mouths/Multi-cavity arched
Define bridge type: Several stone crater bridge Multi bridge openwork bridge



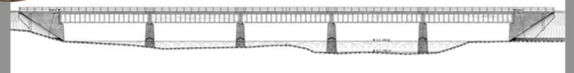
2.B.
Symbol: PVs
Bridge type title: Poly VouteSurbaisses
Bridge type: A few spans of arched sleep
Define bridge type: Multi-span bridges of concrete or rock with low arc height

Type 6:
Symbol: BOX
Bridge type title: Box
Bridge type: Box bridge
Define bridge type: Includes pre-fabricated concrete blocks with spans less than 5.20 meters
Number: 223
Frequency percentage: %0.8



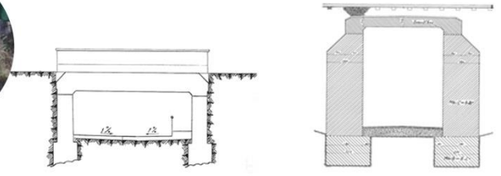
Type 3:
Symbol: FB
Bridge type title: FerBeton
Bridge type: Farbotton
Define bridge type: Bridges with concrete reinforced concrete
Number: 15663
Frequency percentage: %55.6

Type 4:
Symbol: COM
Bridge type title: Composite
Bridge type: Composite Bridge
Define bridge type: A bridge with a deck of a different kind
Number: 35
Frequency percentage: %0.1

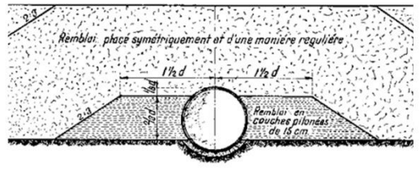


Type 5:
Symbol: PM
Bridge type title: Pont Metallique
Bridge type: Metal beam/Metal truss
Metal Sheet Sheet/Truss + sheet beam
Define bridge type: Bridges with metal deck
Number: 309
Frequency percentage: %1.1

Type 7:
Symbol: D
Bridge type title: Dalot
Bridge type: Dalo (Underwater)
Define bridge type: A kind of bridges (unbreakable bridges) of non-armed or armed concrete with a rectangular cross section of less than 4 meters in width.
Number: 4896



Type 8:
Symbol: B
Bridge type title: Bouses
Bridge type: Bouses
Define bridge type: Abrasive bridges of metal or cement with a circular cross section of less than one meter in diameter
Number: 3502
Frequency percentage: %12.4



Type 9:
Symbol: SI
Bridge type title: Siphon
Bridge type: Dear siphon
Define bridge type: The joy of moving water from downstream to the bottom.
Number: 89
Frequency percentage: %0.3

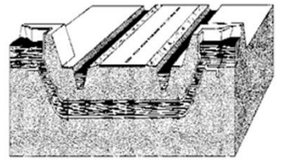
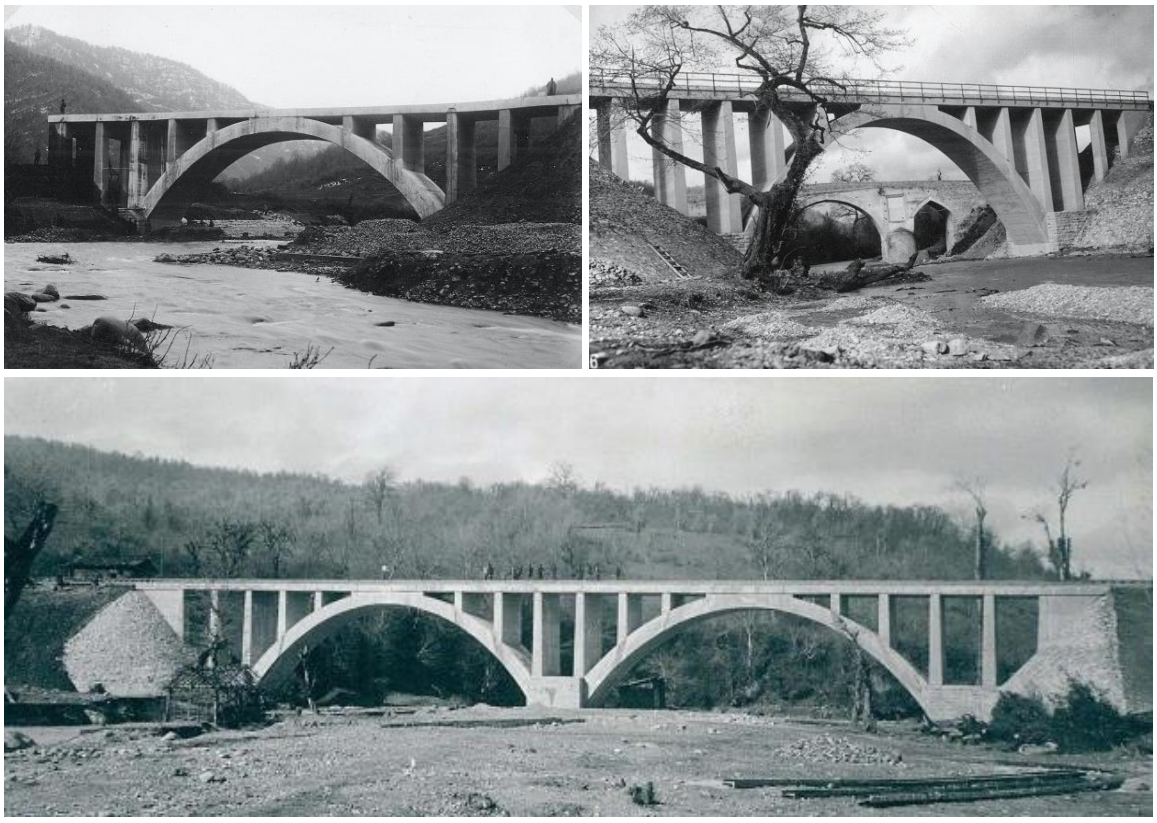


Figure 2.3: Typology of Bridges



Picture 2.87: Three Rainforced Concrete bridge Zirab – Shirgah, North line.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture showing one of the Trans-Iranian railway bridges under construction (between Keshvar and Tang-e Haft stations)

Picture 2.88: Constructing process of a viaduct.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Outstanding Bridges [9]

1- Orim Bridge: is located between Sorkhabad and Veresk stations at the intersection of the railway and Orim ravine. The whole ravine is full of stone and earth accumulated as a result of previous landslides. The railway line construction required the passage of the railway over the ravine through a single-span bridge whose heavy half-piers stood on granites. Due to the existence of an arc line with a radius of 250 m and a 25.6:1000 grade, the task was quite arduous. But following the comparison of several plans on the agenda, it was decided to build an integrated heavy vault with a 64 m-span and a radius of 16.8 m. On either side of the vault, two crescents with a radius of 247.1 were installed. The latitudinal section of the vault has the following dimensions: the vault center: 4 m in breadth and 1.6 m in diameter; pillars: 8.9 m in breadth and 2.8 m in diameter; the overall upper surface of the bridge is 4.7 m in width which follows the railway line axis with a radius of 249.15 m. the vault frame is made of wood and is in the form of a two-piece crescent because laying a fixed frame on this level could have resulted in the falling of clay soil. Several kinds of stone works has been used in bridge body on the upper bearing of the bridge and iron in bridge rails. Orim Bridge has a total volume of 4500 m^3 built at a cost of 2.800.000 Rials.

Picture 2.89: Constructing process of Orim viaduct.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI)

[9] Based on the report by Nutter who was a bridge-building engineer in the book: “the Trans-Iranian Railway”, p 97

Picture 2.90: Orim viaduct (Photo by: Hossein Javadi).

Kalantari Bridge: is another major bridge built on the northern line. Located at a distance of 250-270 km from the port of origin, the bridge is 45 m in height and 112 m in length (7 spans each 16 m long), its slope is 27:1000 and it is over the arc radius route of 250. It is the most important bridge built by Iranian experts and despite the high altitude as well as the large arc and grade of the railway at this spot, it has not followed the main arc design of other big bridges on the route and is regarded as an exceptional bridge.

Picture 2.91: The old and new photos of Kalantari bridge.
Source of the left picture: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

2- Veresk Bridge: is the most well-known bridge of the north built over Veresk Valley near Abbas-abad. It has an altitude of 2140 m above sea-level, a 66 m long span and a 110 m height from the bottom of the valley. Considered as an engineering masterpiece, Veresk Bridge was opened to public in 1936. Built at a cost of 26.000.000 Rials, the total volume of the bridge is 45000 m^3 with a length of 86 m. Its name has been mentioned among bridges higher than 61 m in the Guinness Book of Records in 1989 compiled by John Marshall. Because of its unique features, it has been registered as #1534 on the list of national monuments of Iran. Today passenger trains bound for Sari and Gorgan from Tehran go over the bridge four times on a daily basis going on for more than eighty years.

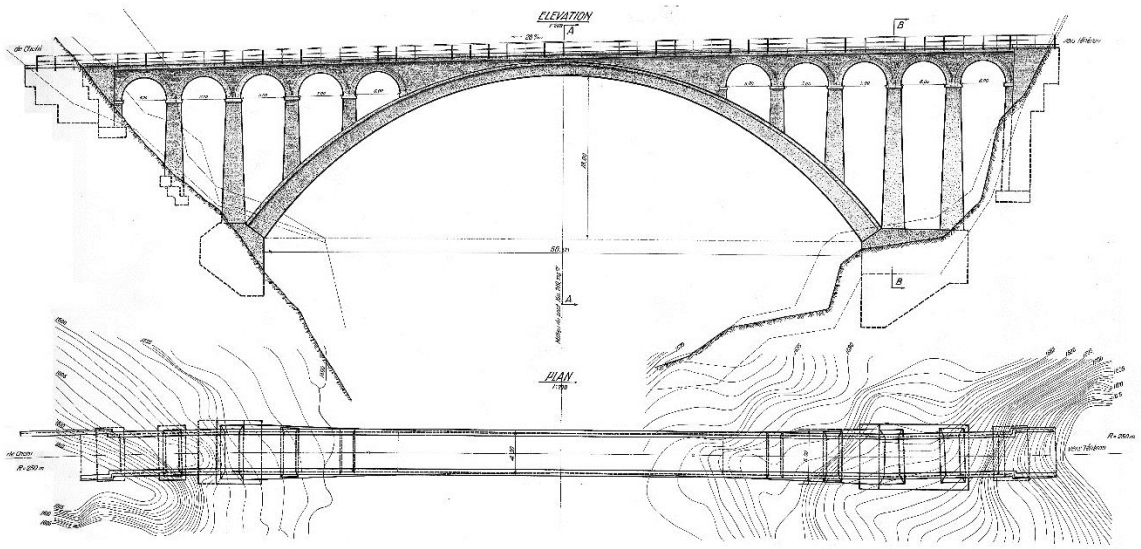


Figure 2.3: Veresk bridge
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Veresk Bridge is regarded as one of the most noteworthy engineering monuments on the northern line. The geometrical form of the main arc of the bridge with its unique complicacy follows a rope-shaped curve with expansive and point loading caused by dead and live loads upon the bridge. The curve of the arc which is four degrees or more leads to a funicular behavior minimizing the bending moment and making the structure produce pressed and membrane behaviors. The sectional thickness of the arch at the support point is 2.80 m and 6 m in width which at the key point amounts to 1.60 m and 4.4 m in width. The entire structure has a brick cover and façade. Its piers, arches and slabs are made of pressed concrete blocks but occasionally a mortar of cement and quarry stone has also been applied.

Scaffolds have been used in the construction of Veresk Bridge. Initially usage of wooden scaffolding was intended but as the wood from indigenous trees could not tolerate strong tensions and the location was not strong enough for scaffolding it was proposed to transfer the lower part of the scaffold to a distance 14 m further down and a more solid structure made of reinforced concrete replace the wooden scaffold. Also due to the constant blowing of high winds at the spot, the frame of the structure was divided into two parts: upper and lower scaffolds.

Construction of the Veresk Bridge began in November 1934 by an Italian company called Pizgalli under the supervision of the Kampsax company and finished in September 1936. Five designers contributed to the project: Yurgen Saxild from Denmark, Harry Haklin from Sweden, Hans Nitter from Switzerland, Vladislav Von Rasovich from Austria and the Pizaglli Company from Italy. The height and dimensions of the bridge make it stand out among other bridges. Veresk Bridge is one of the strategic bridges of Iran built by Austrian and German engineers with a 70-year warranty. During the WWII, 75 trains with 1368 wagons (one train per 25 minutes) traversed the bridge on a daily basis resulting in the delivery of 5 million tons of ammunition. Even Winston Churchill the British primer of the time called Veresk the bridge of victory. Later on 1945, the name Veresk was changed into Piruzi which means triumph in Farsi. Several plans suggesting the use of iron, masonry and reinforced concrete were studied for the bridge but finally the masonry plan was approved because of its cost-effectiveness. Despite the fact that masonry is more expensive than iron, taking into consideration the issue of maintenance (such as repaint and replacement of rivets) it was concluded that in the end masonry would turn out to be cheaper. Moreover a heavy stone bridge in the mountainous areas looked better. Initially it was intended to build the big vault with block stones but apparently the native limestone could not tolerate temperature variations sufficiently and its disintegration was possible. Therefore it was agreed to build the vault from concrete blocks with their layout being precisely calculated. Tests conducted on these concrete blocks were quite satisfactory because their individual strength was not less than 300 kg per cm^2.

Veresk Bridge is a stone bridge of the arch type. The arch form and the distribution of forces upon it prevent the production of tension on the cross section of stone bridges because masonry and stone ballast have insignificant tensile strength. Also longitudinal and transverse cracks in the bridge vault as well as their length, width and depth have a profound effect on the load-bearing of bridges. The bridge stands on eight semi-circle arches with a 5 m-span so that the gravity load of train is transferred to the main arch slab of the bridge with a span 66 m in length. The slab stands on two concrete pillars erected on cliffs on either side of the valley.

Main dimensions of the bridge are: a 66 m open span between the double pillars, a 18 m circle radius, tip of the vault: 6 & 2.8 m, vault center: 4.4 & 1.6 m. Because of the continuously windy conditions of the region, the bridge frame has been divided into two parts: the lower section of the frame is made of reinforced concrete in a jutting shape and the upper part of the frame is wooden and fixed. Formidable anchors stabilize the bridge against high winds. Two strings of leaning cables 36 mm in diameter have been wired up on the scaffolding artificially adding one ton on each meter of the bridge length. Built at a cost of 26.000.000 Rials, the total volume of the bridge is 4500 m3. In addition to its key role in the transportation industry of Iran, Veresk Bridge is also considered as one of its touristic attractions. Vladislav Von Rasovich the structure engineer of the bridge was quoted as saying that:" the most marvelous part of the project on the northern line is the bridge over Veresk Valley with a height of 110 m above the valley bottom. From an engineering point of view, the bridge boasts unique features for example no metal structure has been used in the bridge instead cement mortar, washed sands, bricks and simple tools like hand drills and dynamites have been used in its construction. In other words, the structure is not reinforced and without any armature."

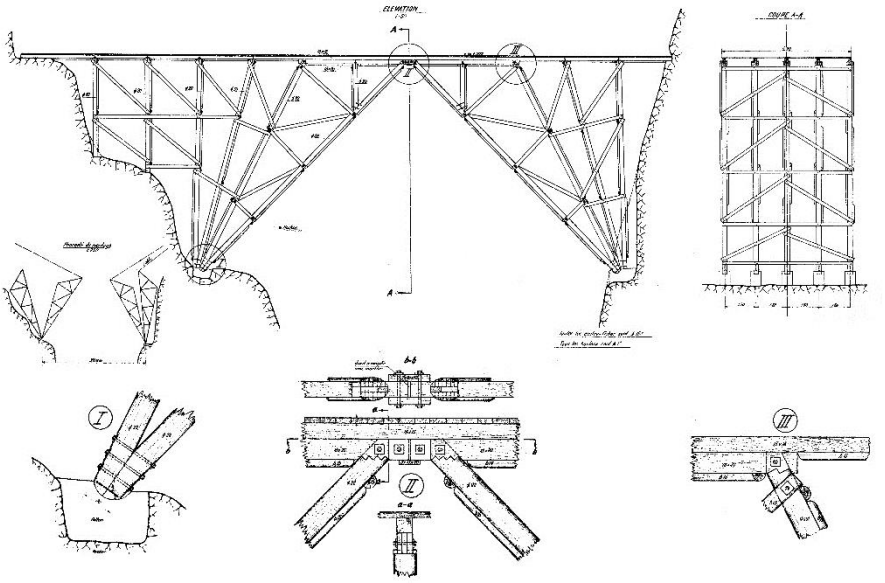
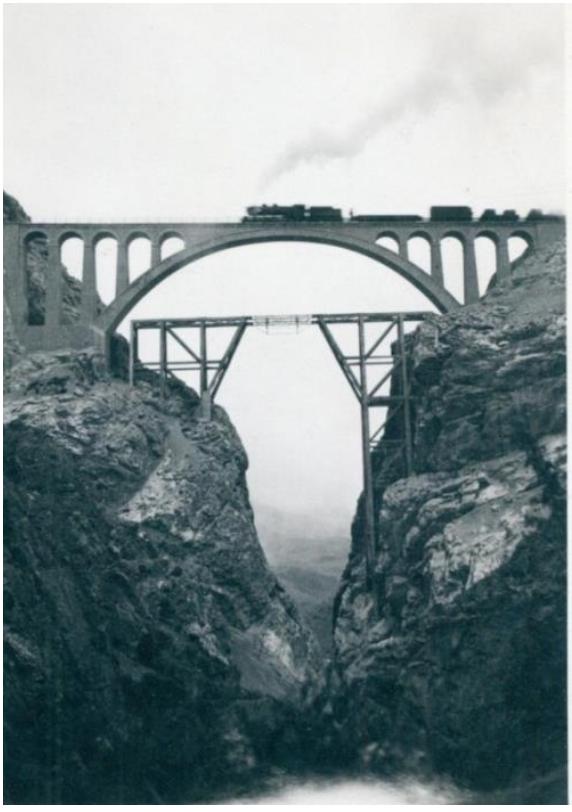


Figure 2.4: Veresk bridge details.



Picture 2.92: One of the large bridges of the cross country railroad at the end of construction (Veresk Bridge).
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

3- Veresk Underpass: although outwardly not as huge as the bridge 110 m overhead but plays a vital role anyway. Veresk River is often waterless but at times of rainstorm the water level might reach as high as 12 m albeit the level line is only 1.5 m above the riverbed making necessary special preemptive arrangements. Increasing the riverbed depth was out of question because the river would be filled with water during heavy rainfalls and inundating the bridge anyway. Taking into consideration five plans that had been put on the agenda, it was agreed to build an artificial tunnel between tunnels #32 & 33 in order to secure the bridge against the most intense flooding. The 54 m-long tunnel has been divided into five sections depending on the watercourse, foundations and local circumstances.

4- Rudshur Bridge: has been built at a distance of 52.5 km south of Tehran on a bend with a 400 m-arc. The railway level on the bridge is approximately 12 m above the riverbed. The riverbed contains a mixture of clay, sand and gravel which are harmful for concrete in the presence of salt water. Rud-e Shur is almost 300 m in breadth. Before its construction several plans using reinforced concrete and iron with a free width were proposed for water passage. But according to the tight schedule set at the time for the project completion it was stipulated that any possible pause in bridge construction must not delay track-laying. Therefore originally a 200 m-long mouth was envisaged for the bridge divided into 6 spans of which the first and last span each were 28 m in length and the width of each of the four middle spans was 36 meters. The most appropriate plan for the bridge was the construction of a metal structure on pillars made of reinforced concrete because only this construction style could meet the timetable set out for the project. As mentioned earlier the railway on the arch bridge had an arc with a radius of 400 meters. Therefore it was necessary to use a reinforced concrete box for its floor ballasting. The box was installed on metal sleepers and sleepers were installed on main beams. The beams are bent in accordance with five lines in the horizontal direction and extend all along the bridge. Their fixed bearing is in the middle while other bearings are movable.

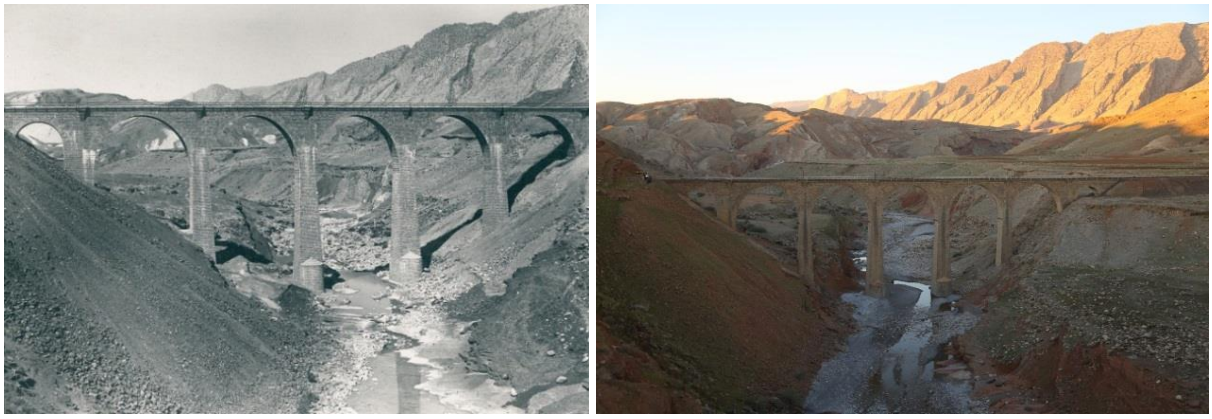
5- Abdiz Bridge: is located 338 km north of Bandar-e Imam Khomeini with a clear span of 60 m entirely made of masonry. This is one of the largest and most beautiful bridges on the southern line. The manner of frame installation and its type attracts attention more than anything else. Even during drought, almost the entire breadth of the bridge is under water thus ruling out the possibility of a bearing set on riverbed using latitudinal retroussé[10] format. Inevitably a two-piece arch frame made of wood was chosen. Both frame pieces were set up above half-pillars within the main pillars using bow towers. Then after the complete assemblage of both pieces, they were turned into a position facing each other by cable in such a way that their heads met at the middle and the gap resulted was closed with a Joint-covering clamp. In order to reduce the load on the frame as much as possible and to decrease the need for wood, the bridge vault was built at five different levels. The load on the frame is as follows: the first level: 100%, the second level: 40%, the third level: 15%, the fourth level: 5% and the fifth level: 2%. In this way, only a third of the vault load will be on the frame. In the fixed frame, the load on the frame and the total weight of the vault are less proportional because of its lower reactivity.

6- Karun Bridge: at a distance of 110 km north of Bandar-e Imam Khomeini is the largest metal bridge on the trans- Iranian railway. It has 51 spans each with an area of 20.75 m and the total length of the

[10] Retroussé i.e. uplifted, upturned

bridge including the piers set between spans amounts to about 1100 meters[11]. The bridge has been built over Karun River, close to the north of Ahwaz and a bit further up a spot formerly used for the irrigation of the local artificial dam. Pillars, half-pillars and foundations of the bridge are made of concrete and set up on stones. Metal poles similar to handrails have been installed on pillars carrying the bridge superstructure. The beams have been placed in the concrete as far as the maximum water height. Bridge superstructure consists of layers of straight main beams connected with iron pieces. Rails have been laid on wooden sleepers without using gravel so that they directly contact the metal structure. On both sides of the bridge, balustrade sidewalks made of wood have been constructed. Karun Bridge has been built without using any scaffolding. Its metal structure was ordered from USA and imported via Bandar-e Imam Khomeini in pieces. In other words, main beams, sidewalks and poles on pillars were initially detached but each span was assembled individually in Ahwaz. After the mounting of poles on pillars, the upper part of each span was installed by powerful rotating winches.

Dom-dom Bridge: built over Dom-dom River near the southern mouth of tunnel #3, the bridge is usually called Dam-dam which means “close to “in Farsi but its real pronunciation is Dom-dom. The arch stone bridge has two, 10 m-spans and five 21.5 m spans with a length of 167 and a height of 42 meters. Headwaters of the river originate from mountains west of the bridge and flowing for a few kilometers after passing below the bridge, the river joins Mazu River and finally flows into the lake of Dez dam.



Picture 2.93: The old and new photo of Dom Dom viaduct.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Semi-circle waterguiding platforms were constructed for the third and fourth piers installed at the middle of the river. These waterguiding platforms are on either side of the bridge pillars in parallel with the watercourse. The architecture of waterguiding platforms of shelters and pillars is similar to Shahbazan Bridge whose pattern has seemingly been adopted from Dom-dom Bridge because the latter predates the former. The area in the vicinity of the bridge is dotted with several tents, habitats

[11] Quoted from the book: “the Trans-Iranian Railway”, p 98; but in “A Brief History of Railway” written by Anatoly Tersinski, p74, the figure is 1057.25m

and villages belonging to nomadic tribes. Therefore, the traffic of nomad pedestrians and their livestock is a familiar sight around the rail track.

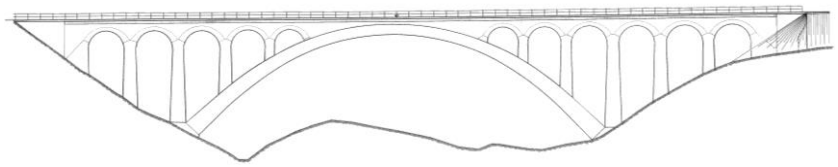
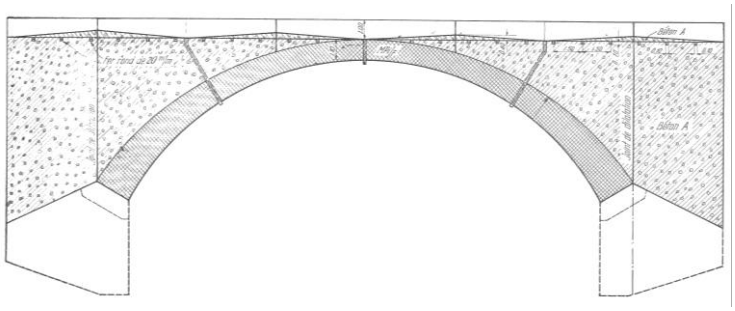
Shahbazan Bridge: following the construction of Dom-dom Bridge, the construction of yet another large bridge became necessary resulting in the construction of Shahbazan Bridge which was built over the seasonal river and a valley, both with the same name near the southern switch (point) of Shahbazan station. With its 50 m height above the river surface, the stone bridge is the highest bridge on Lorestan railway line. Originating from Takht-e Arreh highlands a few kilometers to its north and to the west of the bridge, the seasonal Shahbazan River passes through several villages and after flowing below the bridge ends in the northern tip of the Dez dam river a few kilometers further down.

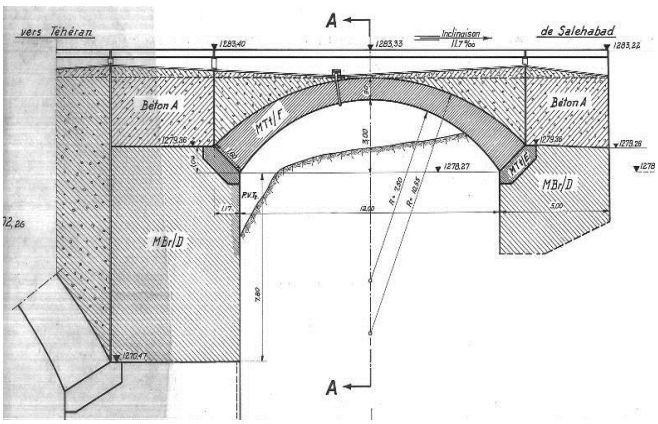
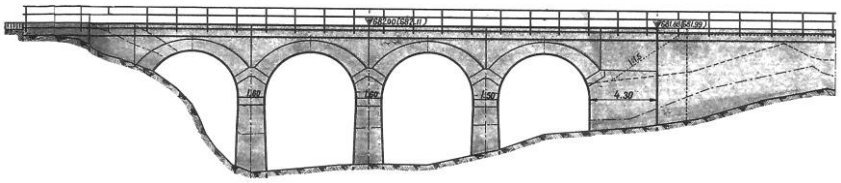
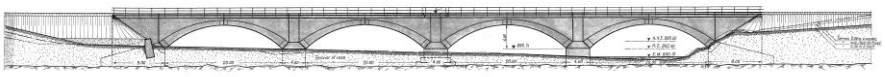
The 184 m long bridge has five 21.5 m-long and three 11 m-long spans with a 15:1000 gradient. The fifth pier of the bridge erected at the middle of the river, has semicircle waterguiding platforms on both sides in the water direction similar to waterguiding platforms of Dom-dom Bridge from an architectural point of view. Due to its proximity to Shahbazan station, the bridge has also been named Shahbazan. Because of the lime and gypsum structure of the Shahbazan area especially at the location of the bridge, a protective stone wall has been built on its southern side extending from the riverbed as far as beneath its last pillar.

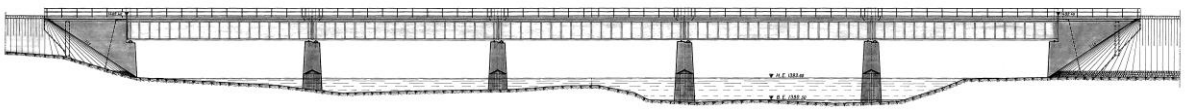
Picture 2.94: Dom Dom viaduct.
Source: TIRRB Archive.

As the construction of the cross country railroad to the south continued, a segment was built which passing through Shahbazan station at a distance of 323 km from the southernmost terminal port extends as far as Dorud 139 km further north running along Ab-e Diz and Ab-e Sezar rivers. This part of the railway was very difficult to build because it crossed twelve deep gorges or straits occasionally with vertical walls requiring the construction of many technical structures such as 120 tunnels and about twenty large bridges or viaducts. Further north the line extends towards Dorud situated 20 km south of Brojerd. At Dorud station, the line diverts eastwards and passing through Azna reaches a higher altitude as it runs north. Finally at a distance of 555 km from the southernmost terminal port, the Trans-Iranian railway approaches its highest point ever near Nurabad Station with an altitude of 2217 m above sea level. Leaving behind this point the line descends towards the northeastern front of the northern plateau of Iran and enters Markazi Province.

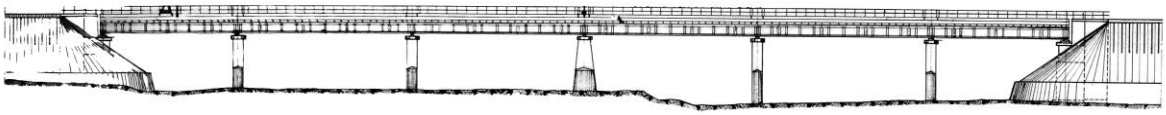
The following table shows the frequency percentage of bridges based on their outward appearance on the Trans-Iranian railway.

Frequency percentage	Number	Define bridge type	Bridge type	Bridge type title	Symbol	Row
11.5%	3236	High Bridge vaulted railway on the valley	Valley vault	Viadoc	VIADOC	1
						
		One stone rock bridge	Arch of a rock crater	Aqueducvoute	AV	2
		Concrete single hinged bridge	The vault of a concrete crater			
						
		Single-span bridges, either concrete or rocky with low arc height	Smooth spine	AqueducVouteSurbaisses	AVs	3

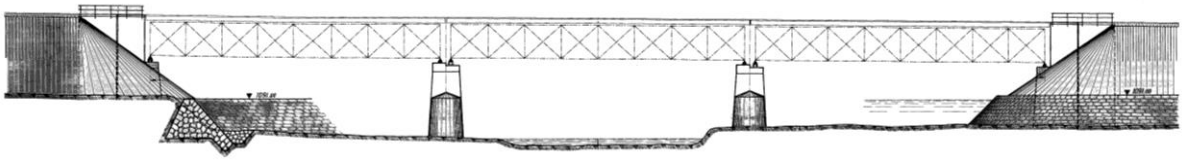
						
0.7%	309	Several stone crater bridge	A few stone mouths	Poly Voute	PV	4
		Multi bridge openwork bridge	Multi-cavity arched			
						
		Multi-span bridges of concrete or rock with low arc height	A few spans of arched sleep	Poly VouteSurbaisses	PVs	5
						
55.6%	15663	Bridges with concrete reinforced concrete	Ferboton	Ferbeton	FB	6



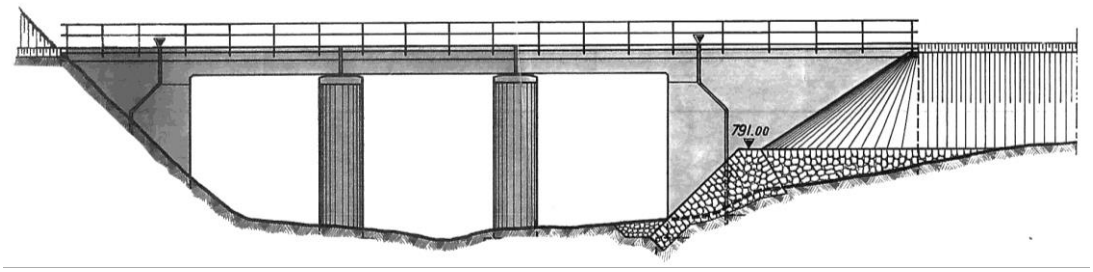
0.1%	35	A bridge with a deck of a different kind	Composite Bridge	Composite	COM	7

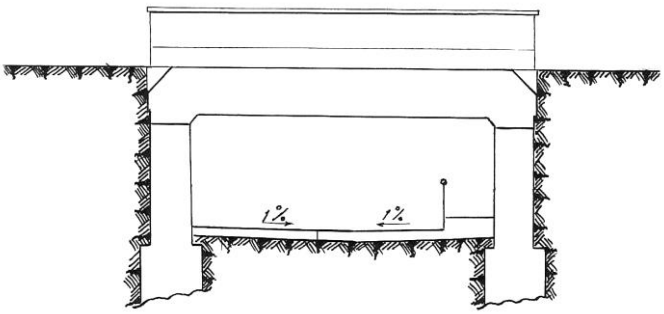
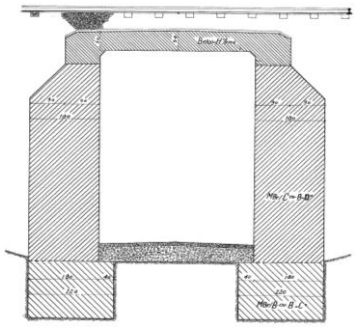
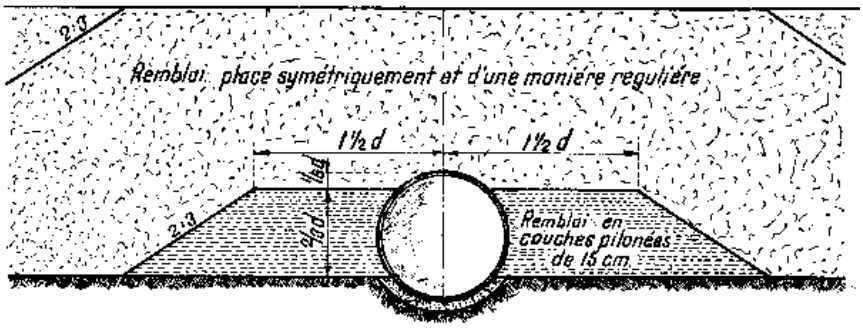


			Metal arc Truss metal			
1.1%	309	Bridges with metal deck	Metal wire Metal Sheet Sheet	Pont Metallique	PM	8
			Truss + sheet beam			



0.8%	223	Includes pre-fabricated concrete blocks with spans less than 5.20 meters	Box bridge	Box	BOX	9



17.4%	4896	A kind of bridges (unbreakable bridges) of non-armed or armed concrete with a rectangular cross section of less than 4 meters in width.	Dalo (Underwater)	Dalot	D	10
 						
12.4%	3502	Abrasive bridges of metal or cement with a circular cross section of less than one meter in diameter	Bouse	Bouses	B	11
						
		Half-circle bosom	Half booze	Semi- Bouses	SB	12

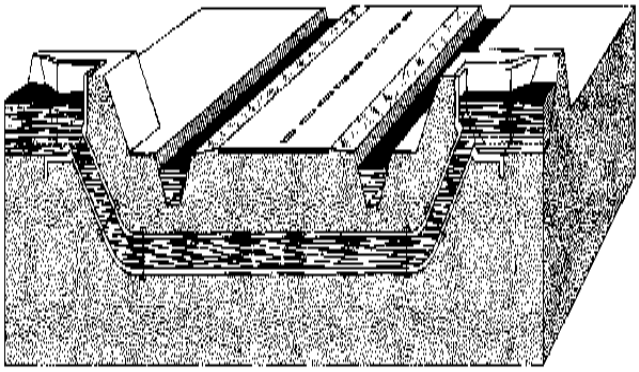
0.3%	89	The joy of moving water from downstream to the bottom.	Dear siphon	Siphon	SI	13
						

Table 2.3: various types of railway bridges of Iran, their number and length.

Se-khat-e-Tala

Following the construction of Veresk Bridge, engineers needed a special plan in order to make possible reaching the necessary altitude to pass through Gaduk Strait. Thus they decided that after going through the Veresk Bridge, the train should travel a short distance leaving behind the foot of the mountain and crossing Talar River again, it should ascend the opposite mountainside. Then after going through a tunnel and a four-span bridge, the train would arrive at Dogal station. Afterwards it should traverse the route at an opposite direction and should go through a three-span bridge. Then after another U-turn, it should reach the third level which is the highest one. Here the train should pass through a six-span bridge, a gallery and a tunnel. These three lines were called Se-khat-e-Tala (triple gold lines in Farsi). Albeit the train would not gain the altitude enough in order to ascend the next mountain; therefore, at this stage, the railway line was designed in the form of an 8 so that the train could gain momentum for reaching the last highlands before setting off for the longest tunnel i.e. Gaduk. The reputation of the special design (Se-khat-e-Tala) owes to the fact that it makes possible a 600-m ascension. In fact, the train has to traverse an extra 25-km distance in order to be able to reach such height before entering Gaduk Tunnel.

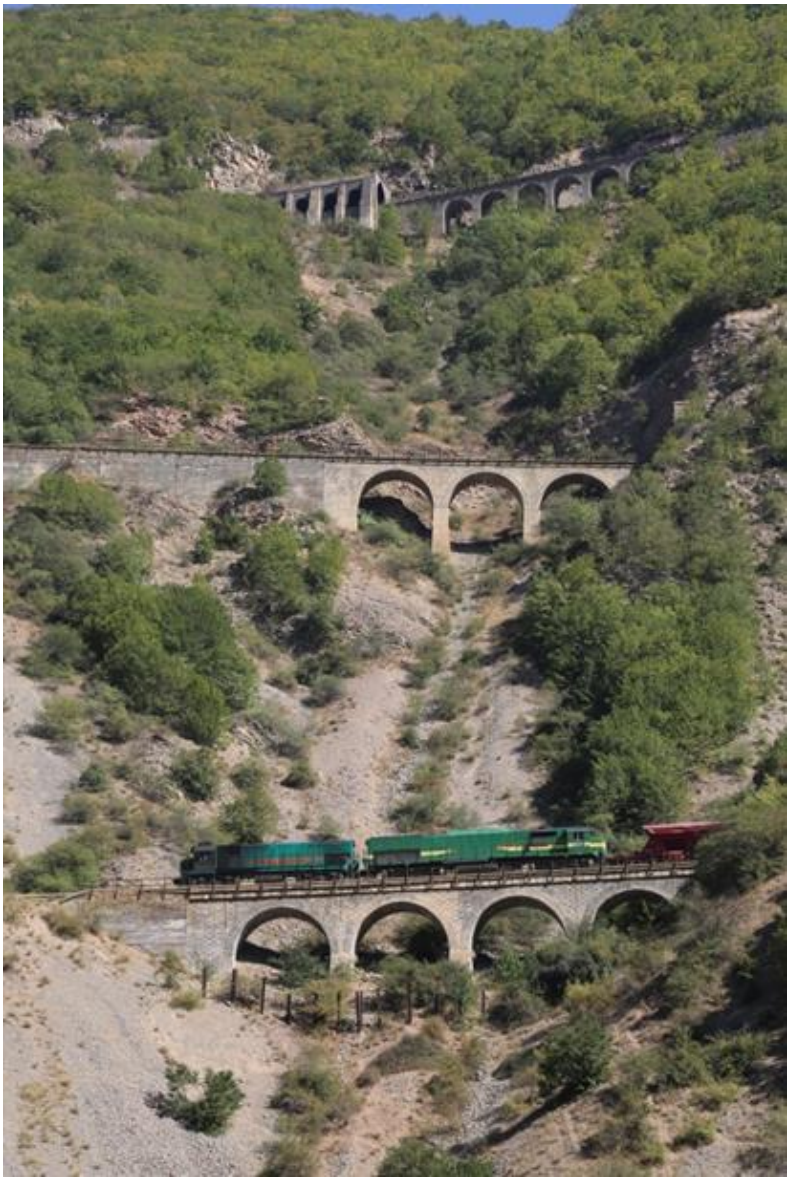
Picture 2.95: Gaduk – Veresk route.

Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI) (Up), TIRRB Archive (Down).

Climbing the northern mountainside was the hardest part of the northern line in which after traversing the Mazandaran plain, the railway arrives at Talar valley before going through Gaduk Tunnel. Regarding the gradient of the mountainside, the syndicate had two plans for this segment; one with a 20:1000 and the other with a 30:1000 grade but both were rejected by the Ministry of Roads. Therefore due to the sheer and occasionally impassable cliffs of Talar valley and taking into consideration the dense forest at its bottom, the syndicate used the stereo-photogrammetric method in order to expedite the operations and to avoid any wasting of time. The method consists of taking multiple pictures of the terrain by airplane and drawing a detailed map based on them.

In 1931, the Syndicate was dissolved and the Ministry of Roads itself continued the research on northern mountainsides with the help of Swedish engineers using the Tachometry method. Given the fact that the length of Talar River was not sufficient for gaining momentum to reach the appropriate altitude, the line had to be elongated by artificial devices. According to plans of the Syndicate, the railway should have passed through subsidiary valleys of the Talar River, therefore most of it would have been located on steep cliffs of the mountainside i.e. much higher than the bottom of Talar Valley requiring the construction of several technical structures such as: tunnels, retaining walls and gorge bridges. But the Ministry of Roads found the plan too costly and challenging instead it settled on a plan as to decrease expenses as much as possible. Finally, it was agreed to build the line at the bottom

of the valley which had a flatter terrain making the work less difficult. Given the fact that near the strait the gradient of the valley increased, after reaching a spot at which the gradient of the river was steeper than the maximum gradient of the track, the railway could no longer remain at the bottom of the valley. Approaching the strait, the valley became gradually steeper and at a specific point in which the river gradient overtook the maximum grade set for railway, the line could not be continued at the bottom of the valley. Most of such increments were made in the form of spirals on mountainsides and sometimes around forked gorges of Talar Valley. Because the present dirt road which serves as the main supply line of construction materials is located at the bottom of the valley, in order to decrease expenses it was necessary to increase the railway length so that it would not get very far or above the dirt road. Thus the extension was not concentrated on one location but was dispersed along the sides of the valley in small increments.



Picture 2.96: Se-khat-e-Tala (Hossein Javadi).

As said earlier, the artificial extensions were generally in the shape of spirals and occasionally adding snail-shaped tunnels were also considered but due to their higher cost, they were generally ruled out. Aimed at preventing potential problems caused by wintertime snowfall on uncovered lines at this height, it was finally decided to dig a tunnel at Gaduk Strait. Although it was possible to reduce the height of the strait through which the line would pass, accordingly an increase in the length of the tunnel would have also become necessary. Another factor limiting the tunnel length was the time table set out for the finalization of the project in its entirety. No major problem regarding the gradient was encountered and as planned the line would run along the Hablehrud valley in the distance between Firuzkuh and Garmsar. Given the fact that the river gradient never exceeds 18.5:1000, the line remains at the bottom of the valley for the entire distance.

2.a.6.4 Railway Stations

Among valuable elements of the railway heritage are: rail tracks, stations, bridges, buildings, equipment and written documents related to the railway. Particularly railway buildings constructed at the beginning decades of the railway industry in Iran are of utmost significance because of their design, structure and effect on the history of architecture. Another major aspect of the historical buildings of the railway is that the majority of them follow a predominant architectural style and are in complete conformity with their natural milieu so that even amateurs can easily understand the beauty of the harmony. It should be noted that many of these monuments especially the central station of Tehran or Firuzkuh Station have been built by famous architects and have exerted powerful influence over the development of modern architecture in Iran. All over the world, train stations are usually built at urban gates and are regarded as landmarks. The so-called organic nature of the architecture of stations is very important which in Iran is interpreted as “compatibility with nature in relation to function”. According to such attitude, optimal usage of natural forces for establishing a comfortable environment is the goal resulting in the assimilation of the building by formation of appropriate body dimensions/directions, flowerbed pits, sunshade factors, ventilation organs and construction materials. In other words, the architectural plan of stations has been inspired by the indigenous architecture of regions, environmental circumstances and compatibility with local nature.

Typology of Stations

1- In large cities (single buildings, compounds)
2- Small towns (harbors, stations and appurtenances)
3- Organizational stations
4- Midway stations

Construction of railway stations in Iran dates from three different periods of time. Among aspects discerning these periods are the construction time and technology, spatial communications and similarities in appearance.

In the first period (1921-1941), the first train station of Iran was built with a classic European façade and by ignoring Persian architecture. After the inauguration of the Jolfa-Tabriz line, the first train station of Tabriz was built in a simple style with a hall, a number of rooms and a columned porch overlooking the railway. The Central station of Tehran is the most important station of that period. Its

construction started in 1927 simultaneous with the initiation of building activities of the Trans-Iranian railway and finished in 1935. With its European neoclassic architecture, this is the most important station on the cross country railroad. Its craftsmanship and design is of high quality. As a matter of fact, the architectural circles of Germany took it into consideration from late 19th century until early 20th century. Features such as spatial relations and an external façade made of glass and cement make the architecture of the station outstanding.

Figure 2.5: Elevation of a station.

Design of subsidiary stations was not high on the agenda in this period; an example was Garmsar station which was designed by Taher Zadbehzad, an Iranian engineer under the supervision of a German engineer by the name of Sayeff. The spatial structure of Garmsar Station is quite simple consisting of a columned entrance space fronting onto the city, a main hall and two external wings. Seemingly the architecture of other stations follows this one which was climate-dependent and inspired by the indigenous architecture. Of course on the northern line, modern elements were also used for example stations for Bandar-e Gaz and Bandar-e Torkaman were constructed near the city at the same direction with the main urban street. Over this period of time, stations were chiefly an imitation of Tehran Central Station in its entirety.

The second period covers the time span between 1941 until 1978 in which three subsidiary lines to Mashad, Tabriz and Kerman were completed. Accordingly the Mashad and Tabriz stations were put into operation in 1947 and 1948 respectively. The branch stations were not much different compared with their earlier counterparts but main stations built at major destinations like Tabriz and Mashad boasted prominent and influential architectures. Additionally they enjoyed state of the art construction technology and their façade architecture has not focused on the “entrance”. Moreover their interior architecture has a basilica pattern which is the architecture of early Christianity and Byzantium. Despite its outward difference, the Esfahan station is mostly similar to Tabriz, Tehran and Mashad stations concerning spatial organization. The architectural style of the building follows the postmodernism movement of the time with followers like Diba, Ardalan and Amanat who were well-known Iranian architects with a proven track record of constructing buildings such as the Azadi Tower and the Fine Arts Museum of Tehran. In the construction of the Esfahan Station on the one hand the

indigenous architecture has been respected because the building volume has been formed like a Safavid pavilion (kooshk) boasting the elements of historical architecture (in particular arch) and on the other hand the use of concrete mixed with stone symbolizes a post-modernist architecture.

The years after the Islamic revolution of 1978 can be regarded as the third period of station construction. In 1984, Sarakhs Station, in the 1991 the Bandar-e Abbas station and in 2009, the Shiraz station were inaugurated. Their design was an imitation of the spatial organization used in the former period which was mainly based on classic architecture principally respecting the symmetry of two side wings for creating more readability.

Tehran Central Railway Station: is the most important and most beautiful building throughout the Trans-Iranian railway. At the time it was considered as one of the best buildings of Iran from an aesthetic and strength point of view. Inspired by the splendid architecture of ancient Persia, German engineers constructed the building in the idealistic expressionism style. The magnificent but plain building has a wide entrance which suggests a sense of passing in the minds of passengers. At the same time the inherent rhythm of windows, openings and encompassing piers lay stress on the grandeur of the building. With an area of 34000 square meters the Central Train Station of Tehran also has a 2 square kilometers of buffer zone for its appurtenances. The structure has been made entirely from iron/cement with iron/bronze windows and an external façade made out of travertine white stone excavated from the Pol Sefid quarry in Mazandaran province. 45 engineers and architects have participated in the drawing of the plan for the station. About seventy industrial and building companies from twelve different countries bid for the contract on the central station but only twelve building firms and twenty industrial companies were given the go-ahead to construct the station and its appurtenances.

The Central Railway Station of Tehran is considered as the point zero for the Trans-Iranian railway. The station also serves as its headquarters centrally controlling and commanding the whole network and its subsidiary stations from a special room with sophisticated equipment. Within a box the bell key to all other stations has been set. So that all the incoming and outgoing trains operate under a central hub adjusting their traffic accurately. The Tehran station has about 32 km of railways with 160 branch lines enough for parking hundreds of wagons and locomotives. The locomotive shed has a capacity for 25 locomotives and a special shelter could accommodate hundreds of passenger and freight cars.

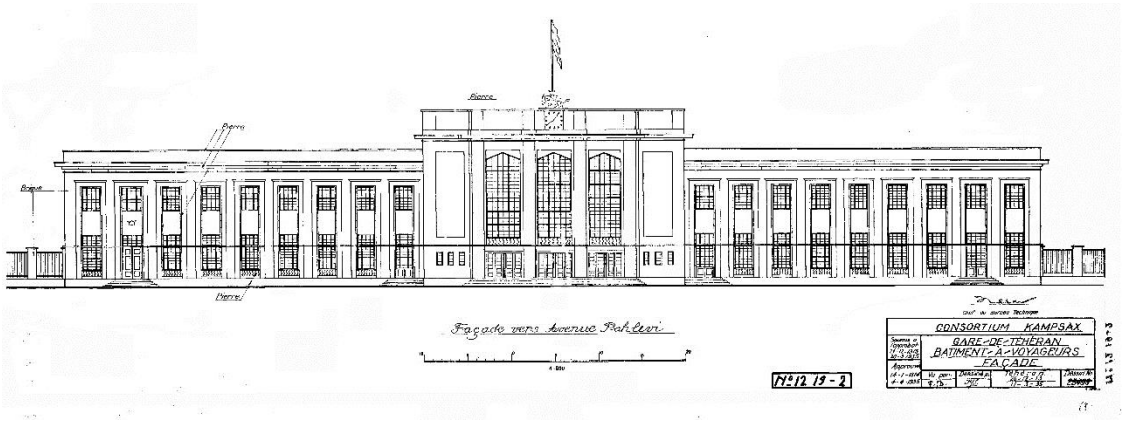
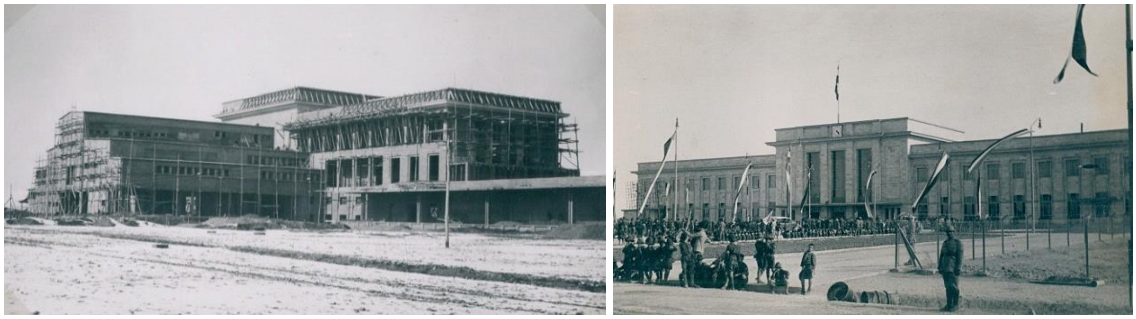


Figure 2.6: Tehran station.



Picture 2.97: Constructing process of Tehran station (Left) Tehran station (Right).
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

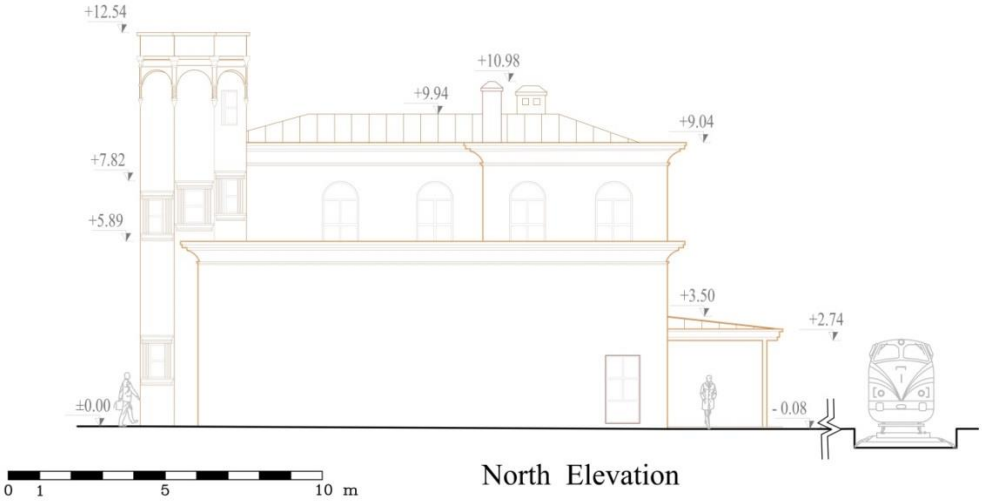


Figure 2.7: Bandar-e Torkaman station.

Picture 2.98: Bandar-e Torkaman station (Photo by: Hossein Javadi)**.**

Picture 2.99: Veresk station.
Source: TIRRB Archive.

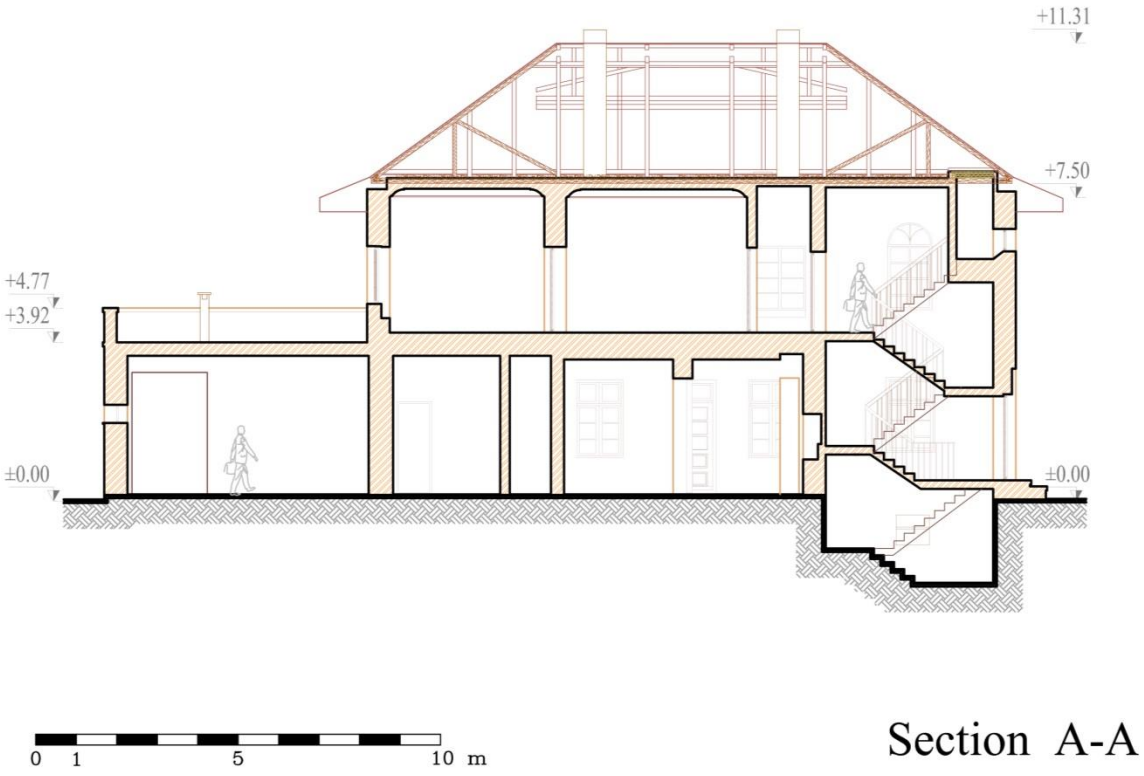
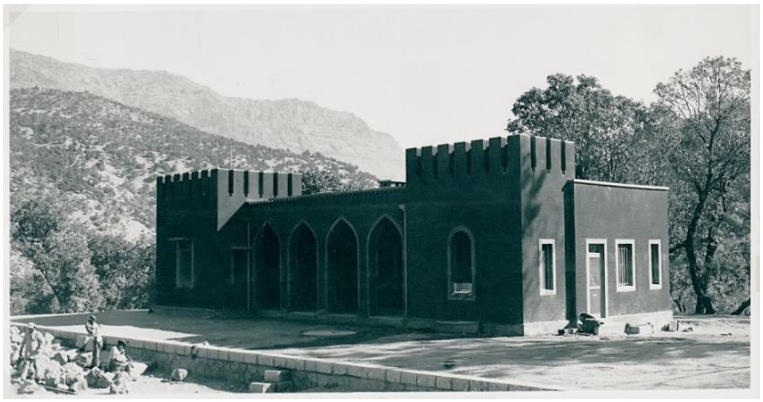


Figure 2.8: Section of Veresk station.



Picture 2.100: Historical photo of Bisheh station.
Source: TIRRB Archive.

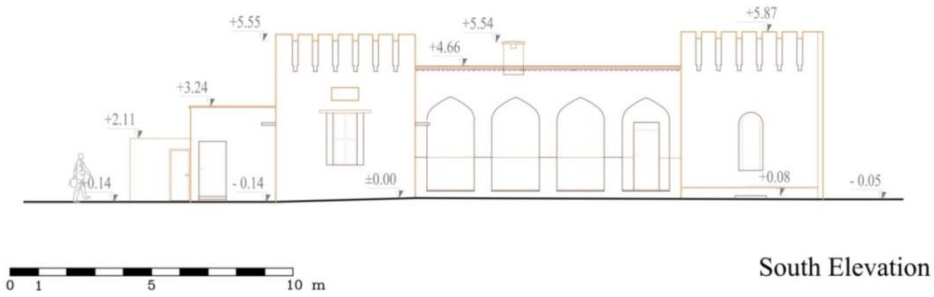


Figure 2.9: Bisheh station

Figure 2.10:Bandar-e Gaz station

Figure 2.11: Bandar-e Torkaman station

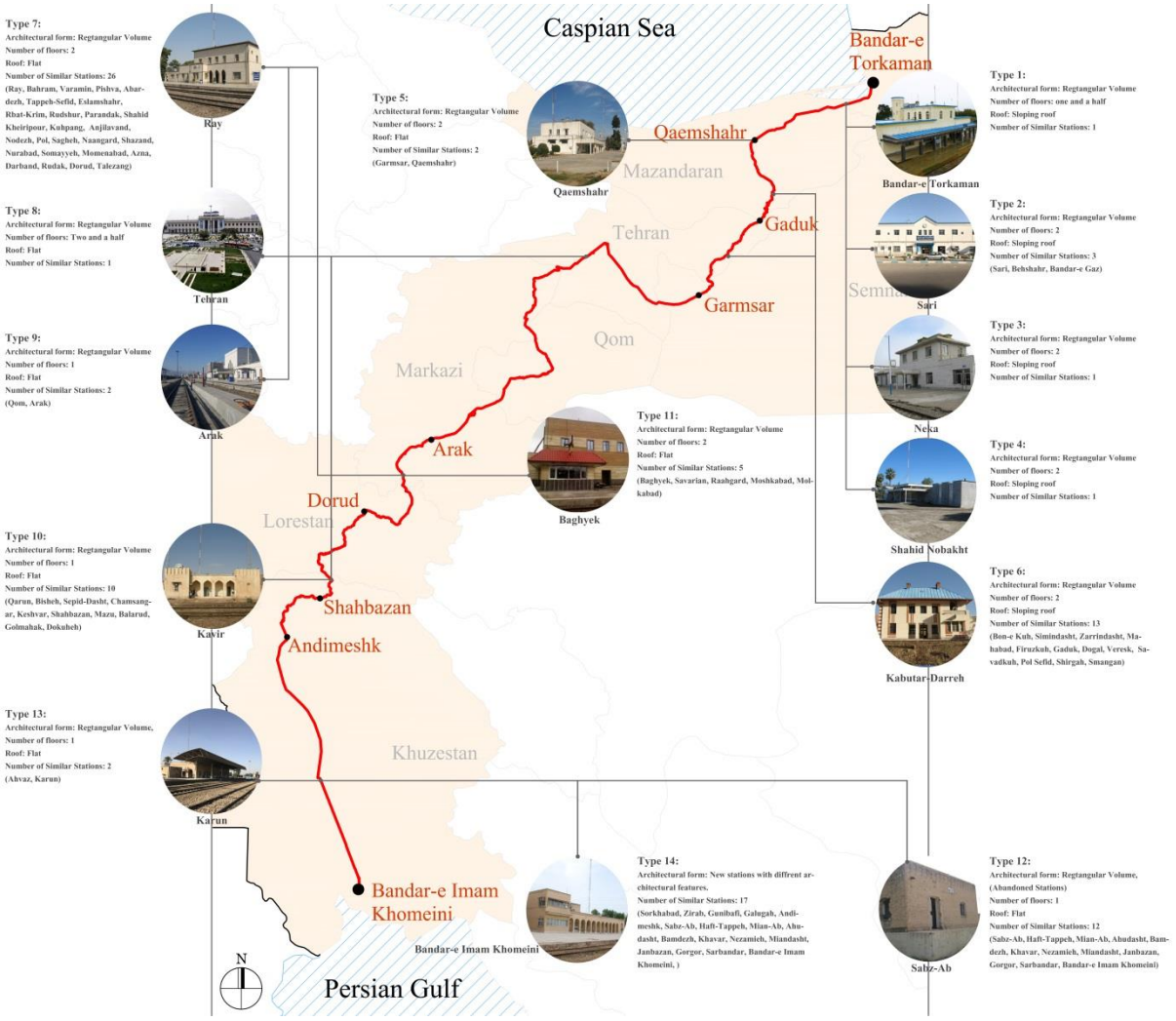


Figure 2.12: Architectural typology of stations. (map: Vol.1, Ref. IV-10)

Name of the station	Location (km)	Distance between stations (km)	Above sea level (m)
Bandar-e shah(present Bandar-e Torkaman)[12]	...	-	23
Bandar-e Gaz	19.450	19	19
Galugah	28.900	9	15
Tirtash	40.350	11	0.19
Behshahr	57.600	17	3
Rostam kola (is omitted now)	66.100	8	1
Neka	81.219	15	37
Dasht-e Naz (is added)	-	-	-
Sari	106.625	25	42

[12] The route extended later to the Gorgan. The new stations are :Gorgan, SizDasht and then Bandar-e Torkaman

Gunibafi (is added)	-	-	-
Shahi (Qaemshahr)	127	20	51
Shirgah	147.490	20	233
Zirab	164.210	16	423
Pol Sefid	175.050	10	568
Do-Ab	192.200	17	906
Sorkhabad	201.710	9	1167
Veresk	214.600	12	1487
Dogal	224.660	10	1733
Gaduk	241.800	17	2209
Firuzkuh	257.450	15	1923
Mahabad	271.500	14	1730
Zarrindasht	286.300	14	1575
Simindasht	298/310	12	1355
Kabutar-Darreh	313.150	14	1254
Bon-e kuh	331.570	18	1006
Garmsar	346.500	14	846
Kavir	372.800	26	792
Abardezh	396.300	23	826
Pishva	408.150	11	900
Varamin	416.950	8	929
Bahram	434.400	17	977
Rey	450.950	16	1052
Tehran	460.850[13]	9	1117
Tehran	933.000[14]	0	1117
Tappeh Seyf (Tappeh-Sefid)	923.210	10	1102
Aprin	912.810	10	1073
Shahriar	896.910	15	1045
Rudshur	873.710	23	1116
Parandak	850.410	23	1187
Shahid Kheiripour (Nahid)	834.010	16	1265
Kuhpank	816.310	17	1157
Anjilvand	799.710	16	957
Nodezh	784.810	14	905
Qom	752.210	16	936
Zagheh (Sagheh)	732.310	19	1102
Baghyek (Bagik)	712.310	20	1353
Savarian	698.210	14	1533
Rahjard (Raahgard)	684.810	13	1700
Naangard	655.610	19	1820
Moshkabad	645.410	20	1685
Molkabad (Malekabad)	624.710	18	1674
Arak	610.710	16	1760
Samangan	593.910	16	1964
Shazand (Azadshahr)	577.610	16	1901
NurAbad	558.310	19	2173

[2] The north routh from Bandar Torkman to Gorgan

[3] The south route from Tehran to Bandar-e Imam Khomeini

Sepid-Cheshmeh (Somayyeh)	542.550	15	1950
Momenabad	524.360	18	1868
Azna	510.560	13	1811
Darband	489.350	21	1688
Rudak	474.420	14	1548
Dorud	462.350	12	1402
Qarun	451.035	12	1307
Bisheh	433.250	17	1168
Sepid-Dasht	419.970	13	1005
Chamsangar	401.290	18	798
Keshvar	386.030	15	696
Tang-e Haft	372.020	14	604
Tang-e Panj	355.005	17	511
Talezanj (Talezang)	337.465	17	421
Shahbazan	323.522	13	355
Mazu	307.486	16	348
Balarud (Balarud)	287.970	19	349
Dokuh (Dokuheh)	266.458	31	159
Andimeshk	250.000	16	120
Sabz-Ab	234.378	15	97
Shush	219.365	15	86
Haft-Tappeh	204.078	15	78
Mian-Ab	188.336	15	39
Ahudasht	173.223	15	33
Dez	155.340	17	27
Bamdezh	150.100	5	26
Khavar	141.340	8	24
Nezamieh	125.68	15	20
Ahwaz	112.000	13	19
Karun	107.500	4	18
Miandasht	95.795	11	12
Khosravi	76.799	18	9
Mansouri	59.760	17	8
Gorgor	39.553	20	10
Sarbandar	12.552	15	4
Bandar-e- Shahpur (Bandar-e Imam Khomeini)	000.709	-	4

Table 2.4:Names and locations of the Trans-Iranian railway stations in 1938.

Later Ahwaz was linked to Khorram-shahr by a railway 123 km in length with the following stations

Station	Location(km)	Distance between stations (km)	Above sea level (m)
Ahwaz	0	0	-
Ab Teymur	20	20	-
Hamid	41	21	-
Ahoo	61	20	-
Hoseyniyeh	81	20	-

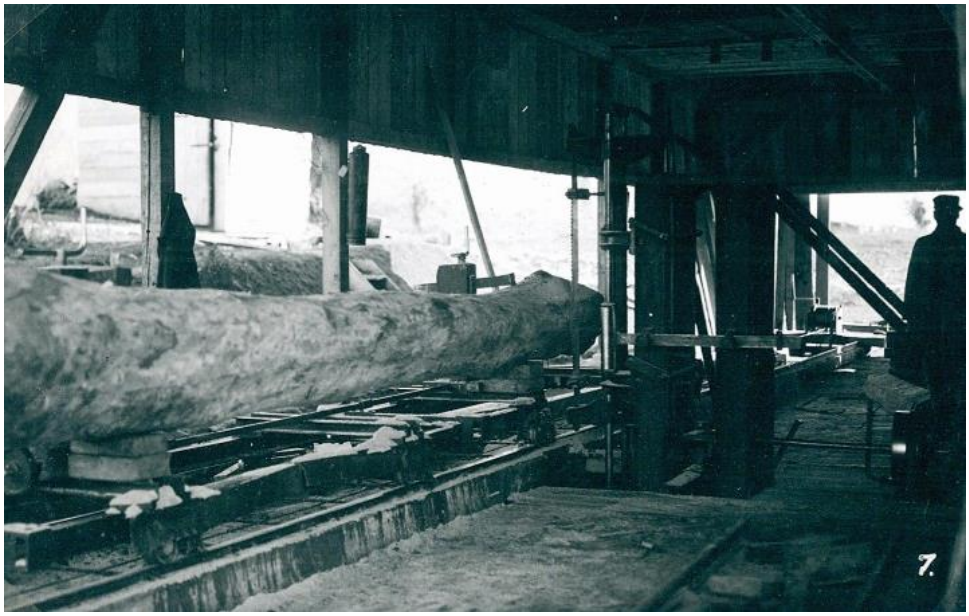
Garm Dasht	101	20	-
Eskele Khoramshahr (Khoramshahr wharf)	123	22	-

Table 2.5: Distance between stations.

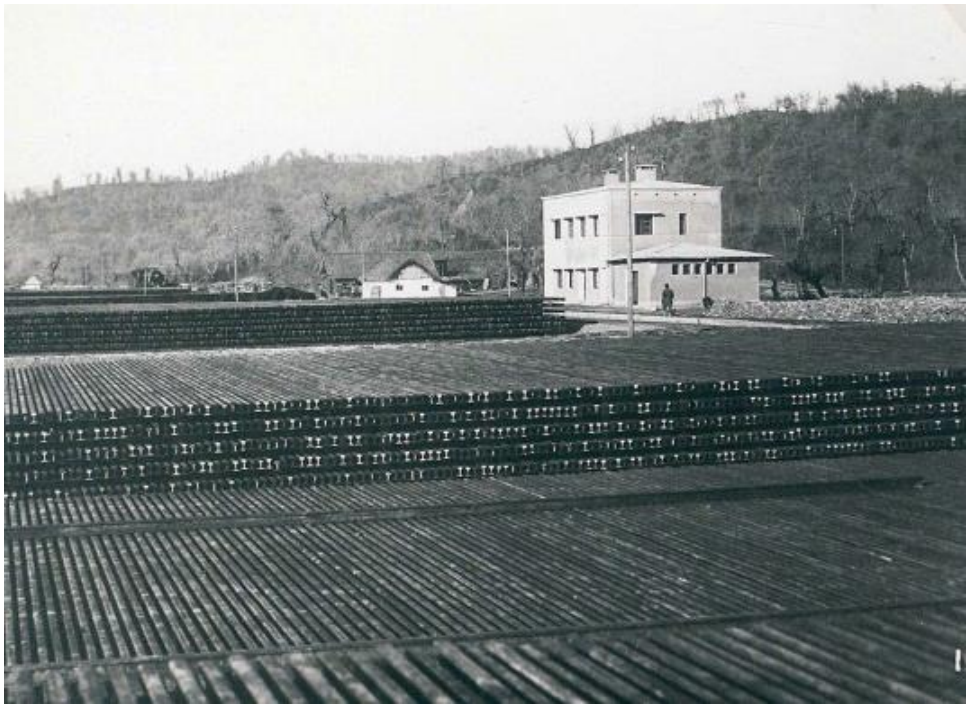
2.a.6.5 Appurtenances (accommodations)

Coinciding with the construction of the Trans-Iranian railway, various buildings such as branch stations, repair workshops, quarters for the staff (workers and clerks), goods sheds, fuel and residual fuel oil storage depots etc. were added as required. Even in the construction of these buildings, the indigenous architecture was taken into consideration in relation to their beauty and solidity. On the whole buildings of the northern line from Tehran to Bandar-e Torkaman have been constructed in the simple western style of the time in contrast to those on the southern line from Tehran to Bandar-e Imam Khomeini which have been constructed in a relatively eastern style. Of course throughout the Trans-Iranian railway attention has also been paid to the indigenous architecture and the local climate as much as possible resulting in a characteristic variety. Buildings for passengers have amenities such as: (warm/cold food) buffets, telephone, ticket booth, changing rooms, roofed platforms, etc… also for first- and second-class passengers, buffet(s), waiting hall, beautiful yards with shaded platforms as well as fountain and pool systems have been built. Beside the lodgings for railway staff and their family, well-equipped guest rooms have also been provided at stations in: Bandar-e Imam Khomeini, Sari, Andimeshk, Ahwaz and Bandar-e Torkaman. Apart from their beauty, these guest houses have running water, electricity, fans and other amenities. As said earlier stations and their appurtenances were designed in accordance with local weather conditions; for example in humid areas, roofs are high with a covering of ceramics or galvanized iron; in mountainous regions, window glasses are hard and double-layered preventing the penetration of cold air and in hot areas roofed porches and cooling equipment have been installed.

Picture 2.101: Historical photo of constructed hospital for workers in Trans-Iranian railway.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).



Picture 2.102: Wooden sleeper factory – North line.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).



Picture 2.103: Rail and sleeper depot.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.104: Kampsax‘s vila.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

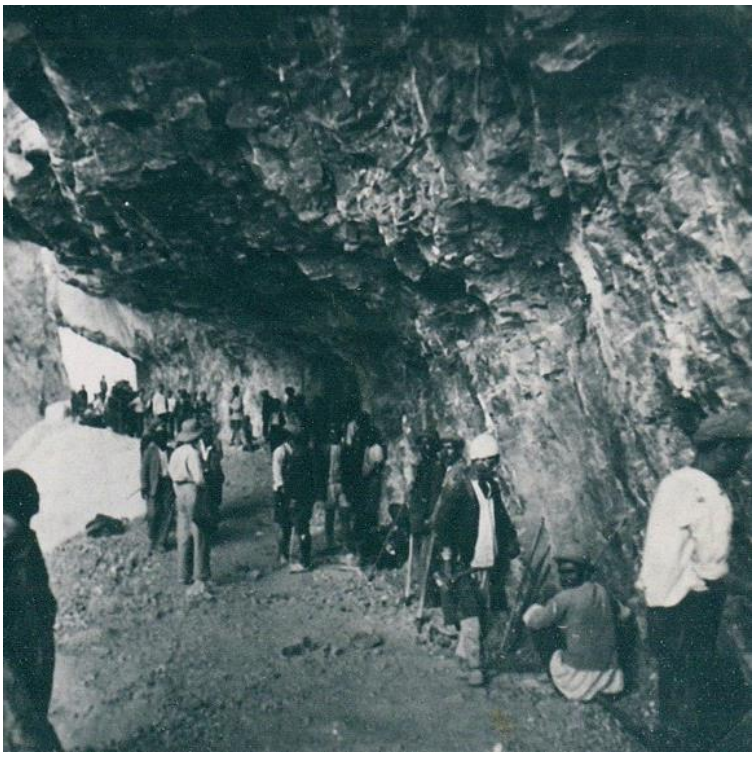
Picture 2.105: Hospital on northern region during Kampsax company construction.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.106: Accomodation for workers – northern region.
Source: TIRRB Archive.

Picture 2.107: The church was built for railway employees – northern region.
Source: TIRRB Archive.

2.a.6.6 Temporary Access Roads (Traffic Lanes)

Construction of temporary roads in the vicinity of railways was a must in order to get access to various points of the route, transfer of workforce, delivery of food supplies, construction materials, etc…on the other hand because of the tight timetable set out for finishing the project, a year round endeavor was needed. Therefore about 1050 km of minor roads were inevitably built among them: the Qaemshahr to Firuzkuh road as well as Tehran-Imamzadeh Jafar and Qom-Arak roads. Albeit due to a shortage of gravel, difficulties in the delivery of construction materials in some spots as well as a lack of funding, the construction of an approximately 105 km long minor road on the northern line between Bandar-e Torkaman and Sari or between Garmsar and Abar-dezh (Qaleh-boland) with a length of 55 km; also on the southern line between Bandar-e Imam Khomeini and Andimeshk (250 km) was cancelled. The most difficult routes for constructing minor roads were in Hablehrud valley on the north line (95 km in length) and in Abdiz Valley/straits (between Shahbazan and Dorud) on the south line.



Picture 2.108: Transportation route in the valley of Abdez river.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

The terrain was so harsh in Abdiz and Absilakhor valleys that for final mapping the construction of a dirt track two meters in width between massive rock formations became necessary. Later the track was widened to four meters so that motor vehicles could also pass through. The 186 km long minor road in Abdiz and Absilakhor valleys turned out to be 56 km longer than the corresponding railway because it went through several successive turns passing through three large temporary bridges and 17 small ones. Also in order to carry construction materials and food supplies from Khorram-abad to Keshvar Station located almost in the middle of Abdiz Valley, a 70 km long minor road was built.

Temporary roads were constructed by railway subcontractors who were responsible for maintenance work until the end of the project. On the whole, about 850 km of temporary roads were built over the span of Trans-Iranian railway construction with surfaces entirely filled with gravel. The figure does not include minor short tracks built for facilitation of work financed by subcontractors. The width of temporary roads was 4 meters and a 10 cm layer of gravel was spread on their surface. By the end of the project, usable roads were handed over to provincial Roads Administrations for maintenance work. The cost of constructing temporary roads was around 63 million Rials of which 52 million Rials was spent only on the Abdiz Valley and for Khorram-abad railway line.

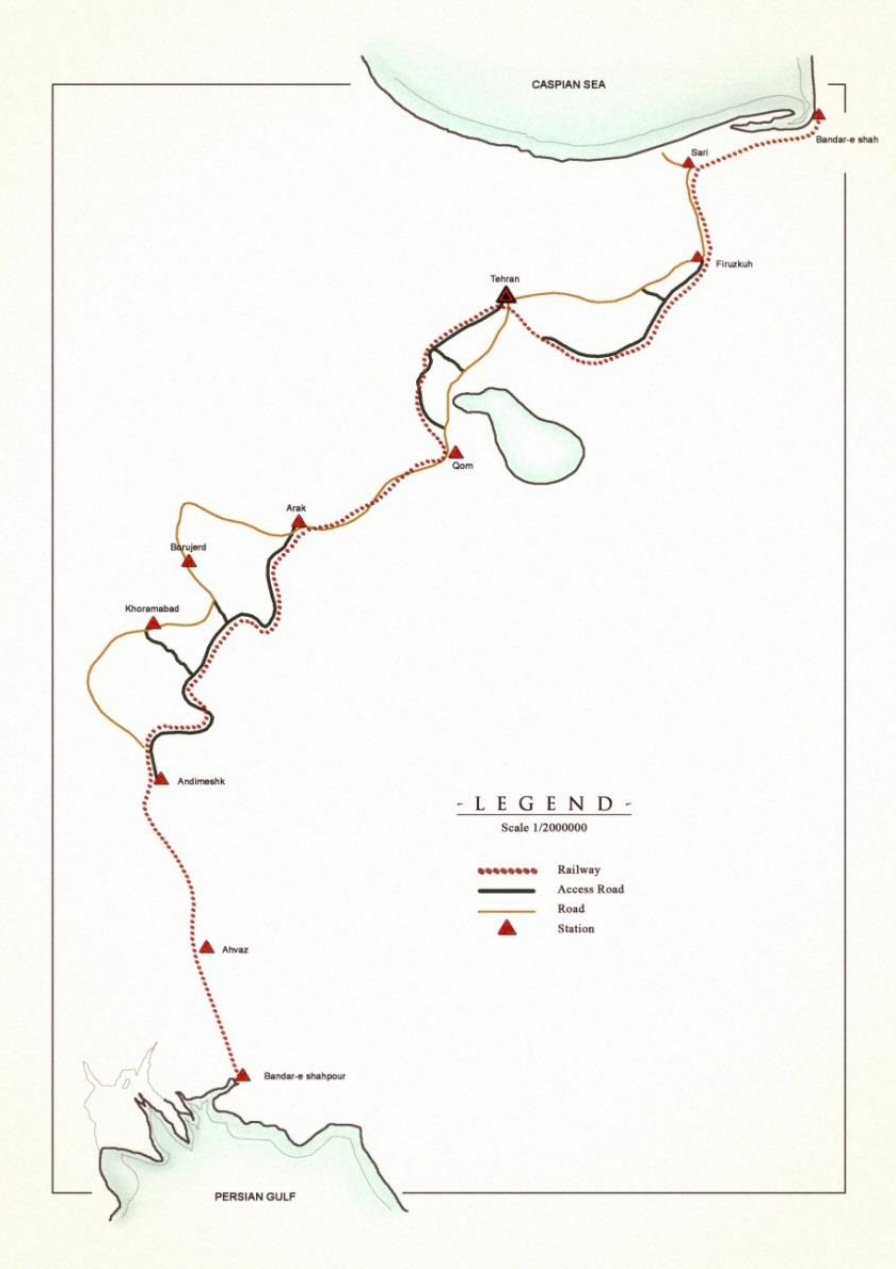


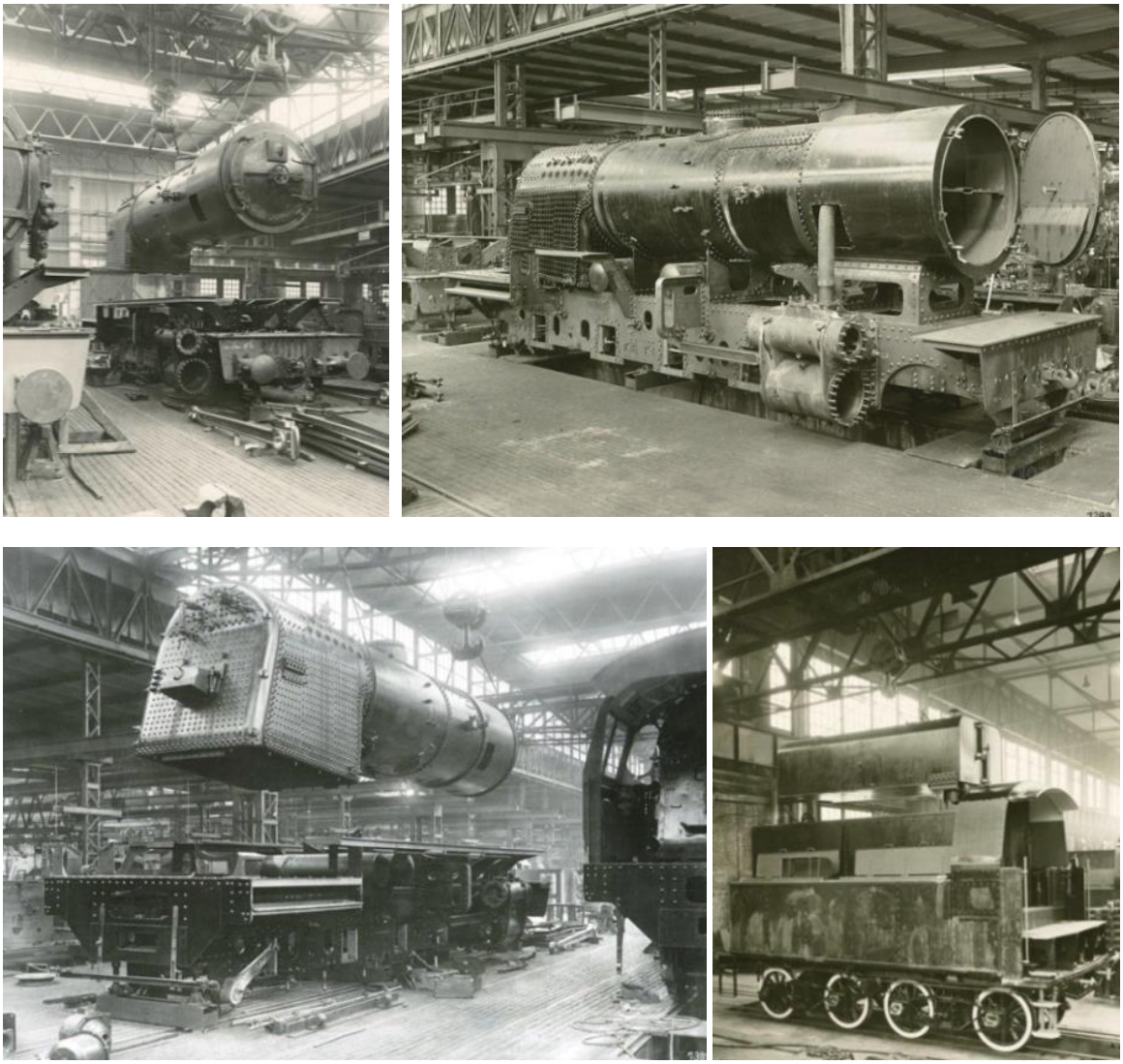
Figure 2.13: Map of temporary roads on the cross country railroad of Iran.
Source: TIRRB Archive.

Picture 2.109: Suspension bridge erected on access road.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.110: Suspension bridge- Talezang – Tang-e Panj route.
Source: TIRRB Archive.

2.a.6.7 Provision of Technical Parts and Rolling Stock (such as wagons, locomotives, road construction equipment, rails, steel industries, cement) for Railway Construction

Appropriate machinery and equipment play an undeniable role in in the setting up of railway projects. The national railway of Iran has a high capacity in preparations for passenger and freight services because of its modern machinery and equipment suitable for operations related to superstructure, reconstruction, improvement and maintenance of railroads. Initially only the state-owned railway administration was involved in such activities but now the private sector also has a hand in it.



Picture 2.111: Locomotive repair factory, Tehran 1938.
Source: TIRRB Archive.

At present more than 3000 of these equipment are available which include light machinery like those used for rail- cutting, bolt-fastening, rail punching and rail heating as well as various welding machinery for rail cracks and drezin machine besides heavy machinery which include a variety of platform installers, tamping machines, ballast regulators, stabilizers, electrical welding machines and etc.. Of course these equipment must be used with a fleet of motor vehicles like different types of ordinary and dump trucks, minibuses and automobiles.

Picture 2.112: Intrance of Locomotive which are used in Iran cross country railway.
Source: TIRRB Archive.

2.a.7 Cultural Characteristics along the Trans-Iranian Railway

Beside the variety in natural sights, various cultural landscapes also characterize the Trans-Iranian railway. As a matter of fact, the line passes through regions with spectacular views of high mountains, vast plains, coastlines, forests and even urban and industrial landscapes establishing a special relation between the railway and various cultural backgrounds on the route.

Railway construction not only speeds up economical and commercial transportations but also shows a new cultural influence concerning cultural interactions and social associations with distant European and western cultures. Also irrespective of its reciprocal effects on one of the most important

fundamentals of civilization i.e. architecture, railway has had a major impact on the lifestyle of ordinary people and their interactions with the west resulting in the creation of a railway-specific cultural landscape throughout the regions covered by the cross country railroad. The north-south route contains multiple natural/historical monuments coming from the culture of different western countries. These monuments alongside the railway phenomenon have been transformed into a unique industrial/cultural landscape. Furthermore, the development process of railway has caused rural/urban developments as well as exceptional cultural interactions carrying diverse outstanding values in different periods of time. Before the construction of railway across isolated Lorestan Mountains, indigenous communities had no other occupation but animal husbandry in these nomadic regions of Iran but after the introduction of railway and the construction of train stations, relations with other parts of the country was established and part of the migration process was passed on to railway. Also train stations became a venue for gathering of farmers and small businessmen and sometimes even permanent human settlements were established in the vicinity of stations. Landscapes created by the railway are either variant or constant. The former is viewed during a trip and varies based on the time and place dimensions so that the onlooker sees a new fleeting scenery continuously. The latter are landscapes made by railway structures and facilities on the adjacent natural environment such as the construction of a bridge over a deep gorge, tunnels built at the heart of high mountains, the passage of railways through forests, sandy terrains, shorelines and also include building facades, railway appurtenances and many other railway-related issues which result in the formation of variegated cultural landscapes all along the cross country line. These landscapes reflect unique cultural and environmental features and are found abundantly and variedly alongside the railway tracks. Different human interventions such as farming, construction works, various industries, relations between human beings and nature, etc… have created cultural sceneries beside a comprehension of natural settings leading to the appearance of various landscapes. Visual link between nature and technology is one of the characteristics of the cross country line. The effect of railway on the cultural backdrop and development beside topological features such as mountains, forests, seas, etc… has occasionally brought about cultural changes bearing various cultural and ethnical marks with a variety of cultural landscapes. For example, Zagros and Alborz mountain chains have resulted in completely diverse cultural circumstances on their opposite sides. Throughout history, these natural formations have always resulted in widespread cultural differences but the railway has created new cultural landscapes in these areas unprecedented before the arrival of the technology. Therefore, it can be concluded that railway has not only has shortened the distances between the areas but has also had a huge effect on cultural developments of them. For this reason, some rail links have a special significance from a cultural or cultural landscape point of view.

Picture 2.113: Geographial diversity along railroad (Photo by: Hossein Javadi)**.**

Picture 2.114: Geographial diversity along railroad.
Source: TIRRB Archive.

Picture 2.115: Geographical diversity along railroad.
Source: TIRRB Archive.

Picture 2.116: Geographical diversity along railroad.
Source: TIRRB Archive.

Cultural landscapes caused by farming and gardening are regarded as one of the most varied and widespread landscapes along the Trans-Iranian railway bringing about a rich cultural diversity. Starting from the Caspian seashores, the railway runs through vast rice fields, cotton and tobacco plantations and citrus gardens reflecting specific conceptual connotations of nature. Entering mountainous areas, the landscape turns into that of apple, walnut and pomegranate gardens. Traversing through the central plateau of Iran, stunning sceneries of salt deserts and Salt Lake are seen in which no cultivation is possible. After the central plateau the train passenger once again passes through mountainous scenes but this time belonging to Zagros mountain chain in which farm crops like wheat, barley and oil seeds as well as garden crops such as grape, fig and pomegranate are planted. Leaving behind the mountains and approaching the Persian Gulf lays the vast fertile plain of Khuzestan which is one of the cradles of civilization and among the first human settlement centers of Iran dating from four thousand years before Christ. Among major cultural landscapes originating from agricultural activity are large farms of wheat, oil seeds and magnificent palm groves.

Picture 2.117: Variety of crops along railway.
Source: TIRRB Archive.

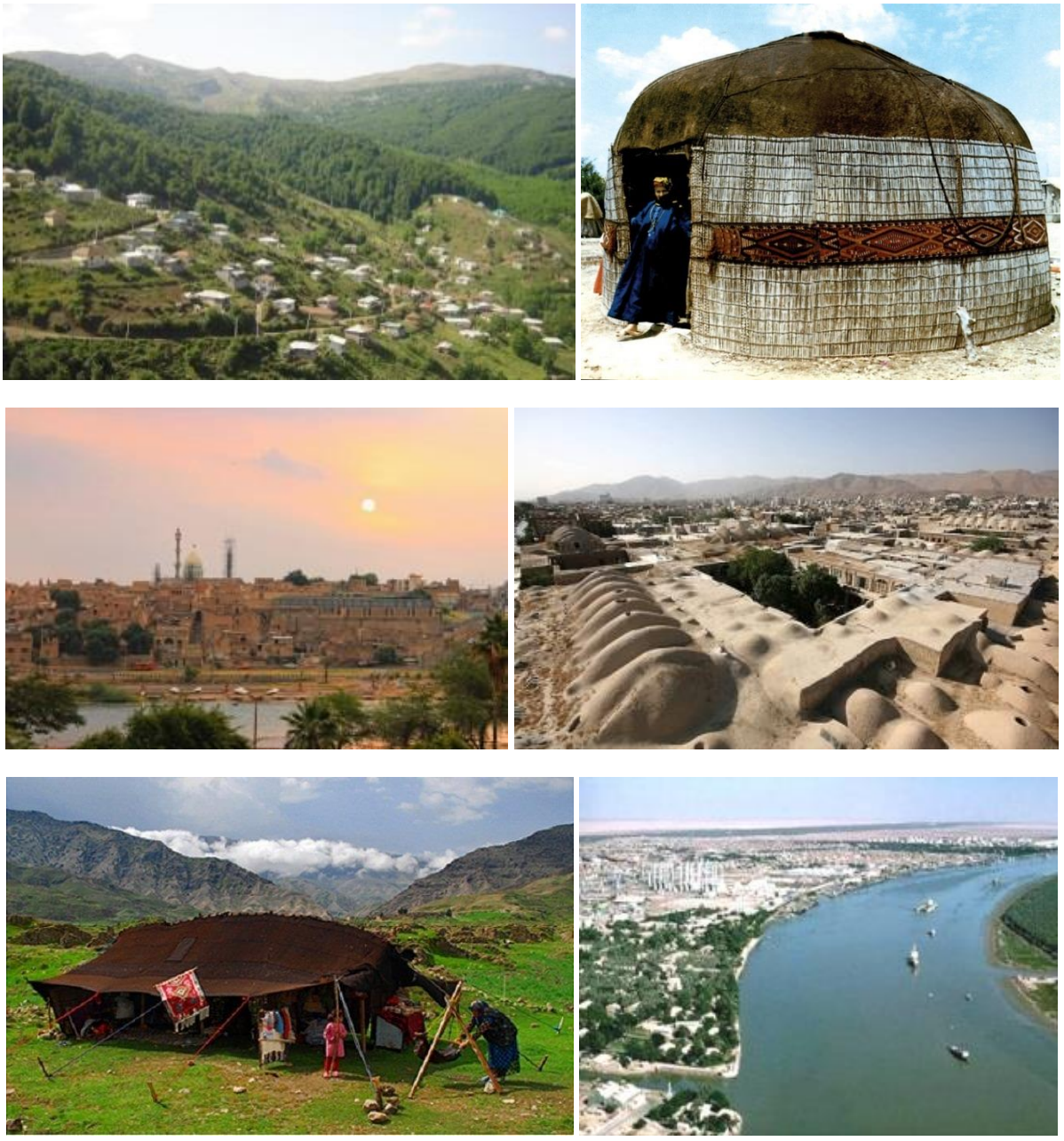
Since the start of the formation of civilizations, Iran has always been an appropriate land for human existence and more importantly for expanding its civil roots and culture. Cultural assimilation with nature and climate has led to civil and biologic concords that are deep, vast and enduring. On the whole, the historical life has always been hard requiring an acute sense of responsibility and awareness

over thousands of years until today. Among distinct aspects of the Trans-Iranian railway is its passage through such a variety of cultures and ethnicities so that along the line, several languages can be heard spoken by: Torkmens, Mazanis, Persians, Turks, Lors, Bakhtiaris, Arabs, etc…also various cultural associations including the intangible heritage of these ethnicities and their traditions such as their dress code, dialects, songs and ethnic customs can be seen. In fact the majority of the intangible heritage is still alive and ongoing in these communities.

Picture 2.118: Cultural diversity along the cross country railway.
Source: TIRRB Archive.

Additionally, the indigenous architecture of various regions located along the cross country railroad has created yet another distinct aspect of the cultural landscapes related to railway. Generally, the vast area of Iran has brought about a diverse architectural culture. Relying on past experiences, craftsmanship and usage of local construction materials, logical methods have been established for providing human comfort based on the highest degree of interaction possible with the surrounding milieu and the indigenous culture. As a matter of fact, regional climate and cultural conditions serve as an effective factor in defining the local architectural style causing a valuable architectural variety throughout Iran. Such a variety in urban planning and architecture can be easily comprehended along

the Trans-Iranian railway so that on the route we can witness: the gabled homes of northern Iran, the simple wooden dwellings of Torkmens, modern urban areas, the Qajar and Pahlavi age architecture of Tehran, traditional architecture of Qom and Arak cities, nomadic dwellings in Zagros mountains as well as houses built in humid and tropical regions of southern Iran. The 1394 km-long Trans-Iranian railway passes through all four main climates of Iran each containing its characteristic architecture based on the indigenous culture. A train trip on this route easily proves the existence of such rich architectural variety.



Picture 2.119: Cultural diversity along the cross country railway.
Source: TIRRB Archive.

2.a.8 Figures and Statistics (construction costs, load carriage, passenger transportation, equipment required,…)

2.a.8.1 The Cost of Trans-Iranian Railway Construction

Pursuant to the law ratified on 9th Khordad 1925, a 2-rial tax on every 3-kg of imported or domestic (granulated or lump) sugar and a 6-rial tax on every 3-kg of tea was charged. It was intended to build the line without any foreign loans. Here is the amount of income generated from taxing granulated sugar, cube sugar and tea between the years 1929 and 1941. Although taxes were collected as of 1925 following the parliamentary approval of the legislation, relevant data on annual taxation was only available from 1929 onwards. Despite this, the amount of tax money received was not enough for funding the project therefore the government had to ask local banks (national and agriculture) for loans which were fully repaid until 1947.

Collected tax (Rial)	Year
86,366,632	1929 (1308 SAH)
84,888,144	1930 (1309 SAH)
71,326,473	1931 (1310 SAH)
101,159,072	1932 (1311 SAH)
97,951,341	1933 (1312 SAH)
112,454,113	1934 (1313 SAH)
127,741,669	1935 (1314 SAH)
104,386,168	1936 (1315 SAH)
175,661,636	1937 (1316 SAH)
174,087,994	1938 (1317 SAH)
190,611,950	1939 (1318 SAH)
196,224,641	1940 (1319 SAH)
117,561,099	1941 (1320 SAH)

Table 2.6: The amount of money earned from (granulated or lump) sugar and tea taxation.

2.a.8.2 The amount of loans given by local banks

From Bank Meli Iran (bmi) in 1935: 150,000,000 (Rial)

From Bank Keshavarzi Iran (bki) in 1935: 70,000,000 (Rial)

From Bank Meli Iran (bmi) in 1936: 60,000,000 (Rial)

From Bank Meli Iran (bmi) in 1937: 90,000,000 (Rial)

Sum: 370,000,000 (Rial)

Aside the money received from taxations and bank loans, some of the earnings from railway and other sources was also spent on railway construction. Here is a brief review of the budget allocated to the railway construction from the start of enforcing the exclusive law for tea and sugar in 1925 until the end of 1938. The money was raised from monopoly of tea/sugar, national reserves, current revenues and bank loans. Also a summary of the spending of the income according to special laws until end of 1938 is as follows[15]:

A) Income

1- From monopoly of tea/sugar

1-1-collected from the beginning of legislation in 1925 until the end of 1937: 1225961654.25 Rials

1-2- the estimated income for 1938: 170,000,000 Rials

Total: 1395961654.25 Rials

2- Net profit

2-1-profit from bank deposit as of 1925 until the end of 1932:15778227.05 Rials

2-2-profit from current account from the beginning of legislation in 1925 until the end of 1933:1116755.65 Rials

Total: 1395961654.25 Rials

3- Other revenues

Income from selling sterling pounds[16] from the beginning of legislation in 1925 until the end of 1932: 1763310.45 Rials

4- Railway revenues

Income from the southern, northern and Azerbaijan sections until the establishment of the Railway Organization (1935): 9223113 Rials

5- Taken from the national budget

5-1-aid from the national budget until the end of 1937 amounting to: 361445700.45

5-2-aid from projected national budget for 1938: 43698639.55

5-3-the projected construction expenditure for 1938 according to the approved budget: 212438639.55

Total: 2089720495.95

[15] The Trans-Iranian Railway, pp. 145-148

[16] In the years 1308-9 and 1932, a large amount of pound sterling was bought for construction purposes but later due to the increased rate of foreign exchange it was sold at a higher rate and a profit of 1,763,310/45 rials was deposited to the bank account of the Railway Organization.

6- Credit in foreign exchange

6-1-from national reserves as of 1934 until the end of 1937 Shahrivar 1941: 2840000 pounds

6-2-from the one-million-pound sterling credit from 1st of Mehr until Esfand 1316 SAH: 250011-9-3 pounds

6-3-from the projected national reserved credits in 1938 according to the ratified budget equaling: 497437-10-00 pounds

Total: 3587448-19-3 pounds

B) Expenditures

1- Expenditures of the ratified tax collections

1-1-cost of tax collection from the beginning of legislation in 1925 until the end of Esfand 1937 amounting to: 3740571.85 Rials

2- Administrative expenses

2-1-administrative costs of the railway from 1925 until end of 1933: 4561755 Rials

2-2-administrative costs of railway supervision from 1925 until end of 1937: 11461251.65 Rials

2-3-administrative costs of railway supervision in 1938 as per the projected budget equaling: 1,260,000 Rials

Total: 11461251.65

3- Miscellaneous expenses

3-1-administrative cost of iron-melting from 1306 until the end of 1308 SAH amounting to: 318062.25 Rials

3-2-cost of Shemshak mine from 1932 until the end of 1933 amounting to: 12159914.40 Rials

3-3-administrative cost of mines exploration until the end of 1309 SAH amounting to: 134835.55 Rials

3-4-the cement factory expenses from 1932 until the end of 1933 amounting to: 15791547 Rials

3-5-repair cost of Zahedan railway from 1932 until Mordad 1935 amounting to: 257,500 Rials

3-6-cost of Nowshahr port construction from 28th Khordad 1933 until the end of the same year amounting to: 2,000,000 Rials

Total: 32875380.20 Rials

4- Expenses of university students abroad

4-1-expenses of university students abroad from 1307 until the end of 1316 SAH amounting to: 11320360.70 Rials

4-2-projected cost of university students abroad for 1938 according to the approved budget amounting to 5202-pound sterling? 416160 Rials

Total: 11736520.70 Rials

5- Constructions Costs

5-1-cost of establishing “the railway syndicate under direct supervision of the Ministry of Roads”: 2549582213.50 Rials

5-2-construction cost from 1933 until 1316 SAH amounting to: 162323642.90 Rials

5-3-the projected cost of construction for 1938 according to the ratified budget: 21243839.55 Rials

6- The cost in foreign exchange

6-1-cost from the beginning of 1934 until the end of 1316 SAH from national reserves amounting to: 28,470,000

6-2-expenses from 1st Mehr until the end of Esfand 1316 SAH from the one-million-pound sterling credit amounting to: 250011-9-3 pounds

6-3-projected cost for 1938 from national reserves based on the approved budget: 4974371000 pounds

Total: 3587448-19-13 pounds

Therefore, the total sum of all five clauses above amounts to 2188334220.35 Rials (the 1938 estimation)

The sum total of income in Rials: 2195180700.40 Rials

The sum total of cost in Rials: 2188334220.35 Rials

Balance: 6846480.05 Rials

The sum total of foreign exchange income in pound sterling: 3587448-19-3 pounds

The sum total of foreign exchange expense in pound sterling: 3587448-19-3 pounds

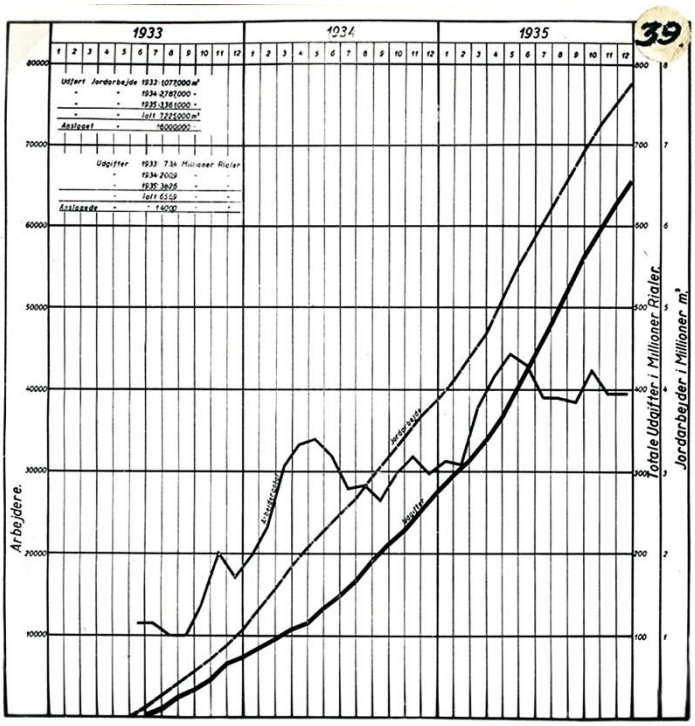


Figure 2.14: Graphic design of the materials amount consumed in the first three years of railways construction.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

2.a.8.3 Values of the Trans-Iranian Railway

The estimated cost of building the Trans-Iranian railway until the end of 1946 has been mentioned in various sources for example in" A Brief History of Railway" written by Terskinski, it amounts to 3158390695 rials including the money spent on network expansion by the Railway Organization. He adds:" it should be pointed out that the real value of rial in the 1926-1941 period was quite different from its value during the Second World War thus the real price of the railway today is several times the above-mentioned amount. Therefore, it is better to calculate the railway price as per the US dollar or gold because of the large oscillations in the value of rial. The Trans-Iranian railway is worth around 212,145,519 $ but due to a change in the value of dollar in 1934 according to the Roosevelt Law, it would be better to estimate its price in gold which has a more constant rate. This equals 188,444,762 grams of gold and can be regarded as one of the most valuable national reserves[17]. "

The list of names of contractors who have worked on construction sections of the Trans-Iranian railway [18] (not including the names of miscellaneous contractors for temporary roads, insignificant buildings, extra operations, etc…)

[17] "A Brief History of Railway" written by Anatoly Tersinski, pp. 86 & 87
[18] "The Trans-Iranian Railway", p 43

Construction Section			Contractor	Nationality	Manager (s)	Total price of the whole construction project (Rial)
No.	location					
	From(km)	To(km)				
	From Bandar-e Torkaman					
6 North	192.500	202.400	Joint-stock company of Anziolini Baloka	Italian	Mr. Baloka	40.509.000(definite)
7 North	202.200	212.500	"	"	"	" 50.866.000
" 8	212.500	220.080	Joint-stock company of Z.R Pizagali	"	Mr. Pizagali	" 45.179.000
" 9	220.080	231.300	Joint-stock company of Metora Sakoperzia	"	Mr, zheroazo	" 61.624.000
" 10	231.300	231.800	"	"	"	" 33.693.000
" 11	237.800	249.000	Broder Rodlishen	Czechoslovakia Iranian	Mr. Gruber	" 40.705.000
" 12	249.000	266.100	Neka company	"	Mr. Khosravani & Mr. Panahi	" 13.748.000
" 13	266.100	282.200	Kavosh company	"	Mr.Aria & Mr. Ghafari	" 16.397.000
" 14	282.200	298.750	Beton company	"	Mr.Jafari& Mr. Maleki	19.695.000(Approx.)
" 15	298.750	315.000	Mr. Hedayat Kalantari	"	Mr. Kalantari	34.045.000(definite)
" 16	315.000	332.000	A.VD. Jorgupulus	Greece	Mr. Jorgupulus	32.070.000 (Approx.)
" 17	332.000	374.000	Jacot company	Greece	Mr. Markof	13.493.000 (Approx.)
" 18	374.000	416.000	Yanikiyan& its partnerships (Rahsaz company)	"	Mr. Yanikiyan	7.324.000 (definite)
" 19	416.000	454.000	Shaba company with limited responsibility	"	Mr. Arjmand	8.592.000 (definite)
From Tehran						
Tehran Station	5.500 North 5.000 South		Qoli Sepahi Soqitech company	Iran Swiss	Mr. Meykadeh& Mr. Mayer & Mr.Kaselhaym	14.204.000 (definite) 48.000.000 (Approx.)
20 North	5.000	51.400	contractory of Shoman	French	Mr. shabur	13.681.000 (Approx.)
21 North	51.400	98.500	"	"	"	16.488.00 (Approx.)
22 North	98.500	145.000	general construction	Iranian	Mr. Tormeln	18.489.000 (Approx.)

		company (cojco)			
23 North	145.000 183.000	Etka company	"	Mr. Shaghaghi	17.551.000 (Approx.)
The construction of the north route buildings was given to a contractor as a separate section:					
North route buildings	127 Bandar-e Torkaman 191	Sazsi company	Iranian	Mr. Zhila	41.977.850 (Approx.)

Table 2.7: The northern line from Tehran to Bandar-e Torkaman.

Construction Section			**contractor**	**Nationality**	**Manager(s)**	**Total price of the whole construction project (Rial)**
No.	Location					
	From(km)	To(km)				
	From Tehran					
20 South	183.000 219.000		Iran-Greece Tech company	Iranian	Mr. Gubulus& Mr. Nosratiyan	12091000 (Approx.)
" 19	219.000 255.000		Neka company	"	Mr. Khosravani & Mr. Panahi	17851000 (Approx.)
" 18	255.000 297.000		contractor company of 18 south	"	Mr. Panahi	" 10780000
" 17	297.000 329.000		Bastan company & Baton company	"	Mr. Javad Ghafari & Mr. Reza Ghafari	" 18243000
" 16	329.000 364.000		Beton company	"	Mr. jafar Zadeh, Mr. Asgari & Mr. Bina	" 122510000
	From Bandar-e Imam Khomeini					
" 15	538.000 569.000		Rey company	"	Mr. Meykadeh	25034000 "
" 14	502.700 538.000		Bastan company & Beton company	"	Mr. Javad Ghafari & Mr. Reza Ghafari	11460000 "
13	461.200 502.700		Rah constructional companies Beton company	"	Mr. Afshar& Mr. Khameneh& Mr. Jafari& Mr. Asgarzadeh & Mr. Bina	15922000 " 19125000 "
12 South	442.700 461.200		Budaghiyan exporting company	"	Mr. Budaghiyan	58119000 "
11 South	425.600 442.700		Sokul construction company	Belgian	Mr. vander Berget & Mr. Vilar	83767000 "
10 South	409.000 425.600		Rail road & public profit company	"	Mr. Nasari & Mr. Divertor	62233000 "
" 9	392.700 409.000		Hokhtif .A.G.Esen company	German	Mr. Bergan	27153000 "
" 8	376.500 392.700		Rail road & public profit company	Belgian	Mr. Nasari & Mr. Divertor	69180000 (definite)
" 7	362.000 376.500		Richard Costen company	English	Mr. Stward	61298000 "

" 6	348.180 362.000	N.M.K company	"	Mr. Vestercard	80465000 "
5 &5	334.400 348.180	Mr. Kofski & Reji company	Iranian& French	Mr. Kolen	64913000 (Approx.)
" 4	323.900 334.400	Etka rail road company	Iranian	Mr. Shaghaghi & Mr. Mosadegh & Mr. Barbro	57071000 (definite)
" 3	312.600 323.900	Joint-stock company of Anziolini Baloka	Italian	Mr. Baloka	30232000 (diffinite)
" 2	300.000 312.600	Razan company	Iranian	Mr. Esfandiyari & Mr. Shafeea	" 5957000

Table 2.8: The southern line from Tehran to Bandar-e Imam Khomeini.

2.b History and Development

Introduction

In ancient Persia, a regular and efficient system of transportation was needed in order to disseminate news, communications, transactions and messages. For this reason, the usage of wheels and transport vehicles has a long history throughout the land of Persia.

Before the inauguration of the Suez Canal, Iran served as the sole commercial link between India and Europe resulting in the construction of caravan routes almost across the whole country. During the Safavid era, the importance of the Iranian Plateau increased even more because of a boom in the Iranian silk trade in Europe. But later the invention of more modern transport means beside the discovery or construction of new sea and land routes led to a huge decline in trade and transit through Iran despite its prominent strategic location. Shortage of transportation vehicles as well as separation from the international network added to the problem. As a result, the need for modern communication routes particularly railroads was felt more than ever. Additionally, linkage to foreign countries could make possible the sale of domestic goods in markets abroad and could bring in huge transit incomes.

From a strategic point of view, the railway has always been important for Iran because the security of its long borders could only be maintained by the construction of sufficient roads especially railways. Moreover, this could not only improve the local economic condition but also would certainly revive domestic industries. On the other hand, railway also served as the best possible access to open seas making the importation or construction of factories and the development of industries much easier. As a matter of fact, cargoes related to industrial facilities are always heavy and voluminous therefore their import is very difficult without the usage of railway.

On the whole, railway acted as a prelude to the arrival of modernity and technology to Iranian cities. Furthermore, railway can also have profound economic, cultural and social impacts as an example it has become a major part of the historical memory of Iranian industries.

Among other merits of the railway mention can be made of its effect on attracting foreign tourists, making trips more comfortable, getting people acquainted with customs and spirits of others as well as strengthening the national unity. As a result, since a long time ago, not only high-ranking authorities but also intellectuals considered railroad as a harbinger of reforms paving the way for progress and liberation.

Present borders of Iran contain a large chunk of the great Iranian plateau in Asia because they are situated at the crossroads to the Far East, India as well as to African and European continents. Since the distant past, major trade roads such as the so-called Silk Road and the Spice Route passed through Iran linking the three continents of Asia, Africa and Europe together. Even today air corridors of Iran perform a similar function making the country a major air transit hub in the world. A glance at a geography map shows that: to its north, Iran borders the republics of Armenia, Azerbaijan and Torkmenistan which link it to European countries via roadways and rail connections as well as through sea routes of the Caspian Sea. To its west and southwest, Iran neighbors Turkey and Iraq which link it to the rest of the Middle East nations as well as to Mediterranean countries via good rail connections and roads. To its south, Iran has long shorelines on the Persian Gulf and the Oman Sea which provide marine access to the rest of the world. Finally, to its east, Pakistan and Afghanistan link it to other central and southern Asian countries. All of these facts, reveal the prominent position of Iran in intercontinental transportations.

The Arrival of Railway to Iran and its History

Materialization of railway in Iran is a symbol of its new-born industrialization, therefore a review of the industrial upheaval of Iran is impossible without a brief study of the history of railway construction. The Iranian railway was built during a complicated economic and political period in which the change of government from Qajar to Pahlavi as well as the policy of strong nations of the day played a key role. Its construction brought about numerous issues and problems in various political, economic, social and cultural domains which are presently worth reviewing as it is a major heritage of the past.

In the aftermath of the industrial revolution and the developments occurring in the western world, eastern countries including Iran went through a transitional period turning from a traditional to a more modernized state. One sign of falling in line with these developments was feeling the need for the construction of railways in order to fulfill national interests and recognizing its role as a prelude to the industrialization of Iran in that era. As evidenced, the process of formation and initial construction of railway began during the Qajar rule but its serious implementation and utilization occurred under the Pahlavi dynasty.

History judges former generations, accordingly all the activities and services of rulers and individuals will be written for future judgments.

The idea of railway construction appeared more than 120 years ago in Iran. As the material and spiritual relations between east and west increased in the second half of the 19th century, the first phenomenon attracting the eyes of Iranian thinkers was the railway which was regarded as a manifestation of the European civilization. All the patriots of the time reached the conclusion that railway could act as a catalyst for the all-round progress of the country.

Railways during the Qajar Era

The concept of railway construction appeared in the second half of the 19th century during which political and cultural ties between Iran and European countries expanded under the Qajar rule (Mokammeli, 2000). In his memoirs, Lord Curzon writes that all the dignitaries of Iran including the

Shah were aware of the importance of railway and knew that its construction guaranteed future advancement of the country. Accordingly, the chancellor of Naseroddin Shah told me that Iran has no choice but to build a railway network in order to reach the rank of European countries (Curzon, 2008).

Picture 2.120: Railing in Tehran during Qajar;
Source: TIRRB Archive.

In a letter written by the French emperor Napoleon the third to Naseroddin Shah dated 14th April 1858, railway has been mentioned for the first time in official documents of Iran. In the letter which was written after the returning of Farrokh Khan Aminolmolk from the French embassy, the issue of the railway which was to be constructed by the English between Istanbul and the Persian Gulf as far as India had been brought up. Actually the project got underway in 1856.

It should be pointed out that even before the first trip of Naseroddin Shah to Europe, representatives of western states were actively in a competition to get a concession for railway construction in Iran. As a result, they were occasionally given exclusive concessions against the long-range interests of the country. On the whole between the years 1228 and 1303 SAH (1850-1925), 31 proposals in this regard were submitted to the government of Iran without any success.

According to formal documents, all such requests were rejected because of a shortage of investment, absence of relevant knowledge or lack of operational capacity. Finally, Baron Julius Reuter who was a British capitalist sent his proposal by telegraph but despite his physical absence somehow managed to obtain the informed consent of the Shah on 25th January 1872. As seen in the clauses of the contract, it was decided to link Tehran to the Caspian Sea and then southwards to the Persian Gulf and later at the discretion of the contractor, the railway network could be linked to Europe or India if possible.

Political disputes between Russia and Britain produced problems for the Reuter contract therefore after the return of Naseroddin Shah from St Petersburg, its cancellation was announced apparently because it was behind schedule one year after the signing of the contract.

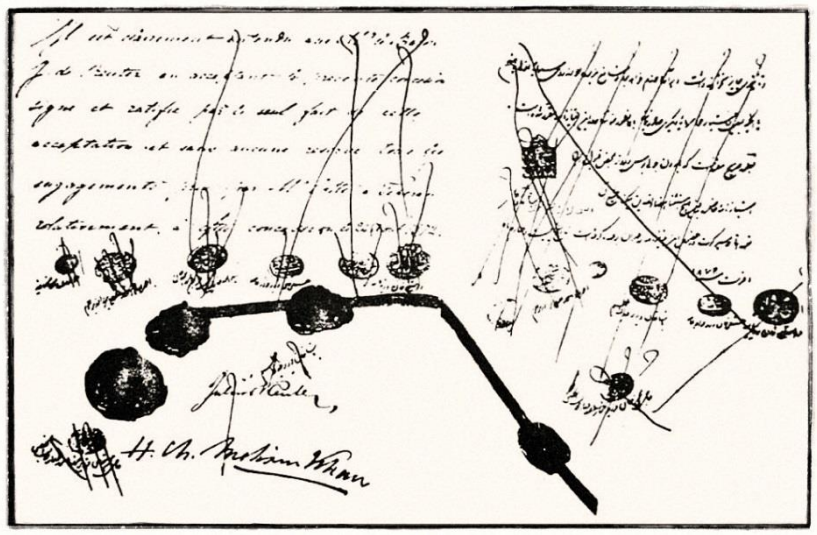
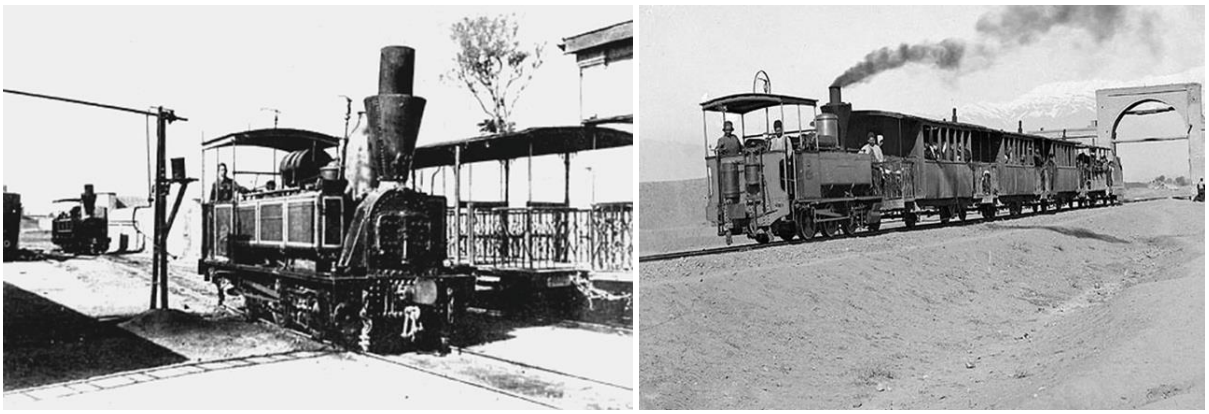
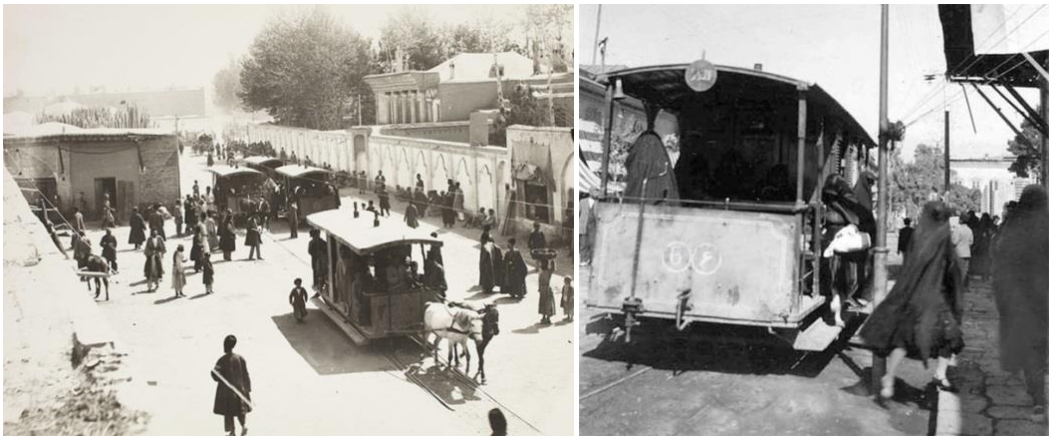


Figure 2.15: Last page of the Reuter contract after its termination showing its stamps crossed out (by Naseroddin Shah);
Source: Mokammeli, 2000 But the first operationalized contract belonged to the French engineer Fabius

Boital who despite his failure in getting a concession to build the Rasht-Tehran-Bushehr railway, tried his chance again and managed to win a permit for constructing and utilizing the Tehran to Shahr-e Rey (Hazrat-e Abdol-Azeem shrine) line for 99 years on Azar 1265 SAH (December 1886). Later the French engineer decided to sell the license to a Belgian company which invested two million francs on it. The railway line was inaugurated at a special ceremony in 1888 and was still in public use until the early years of the Pahlavi the II's rule.



Picture 2.121: Wagon and locomotive of the Tehran to Hazrat-e Abdol-Azeem line;
Source: Mokammeli, 1948



Picture 2.122: Tehran tramway (horse-drawn railway)
Source: Mokammeli, 1948

At the beginning of the 20th century, Iran was in dire need of reforms both from a political and an economic point of view. In this regard the issue of railway construction became the most pivotal aspect of economic reforms. Among the proposed cases, there were also contracts that became operationalized albeit for a short period of time and on a small scale as follows:

* In 1886 an Iranian merchant by the name of Haaj Mohammad Hussein-e Aminolzarb managed to obtain the permit for mining in Amol as well as for building the Mahmud-abad railway from Naseroddin Shah. He even intended to extend the line to Tehran but had no success whatsoever.

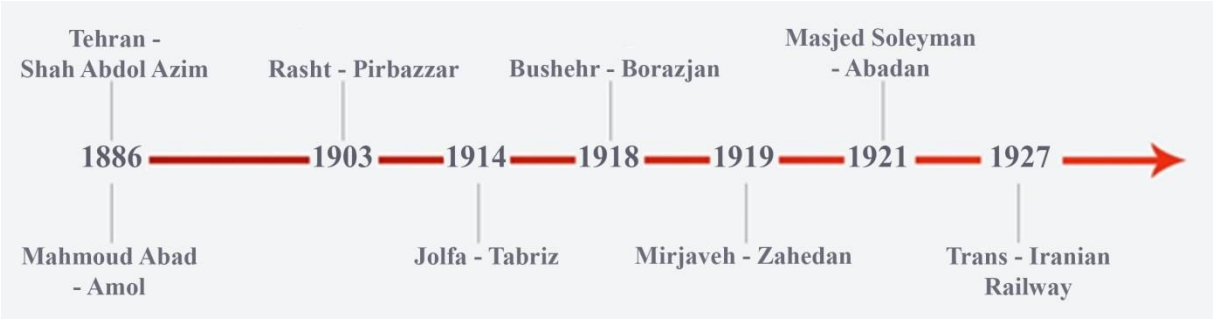


Figure 2.16: Chronology of Iranian railway (By: Meraj Sharifi).

* In 1903 a narrow railway line was constructed for shipping stones from Poonel mine to Anzali Lagoon with a length of 23.5 km but remained mostly out of function.

* Also a short railway line was constructed for carrying mountain stone to the building site of Nowshahr port but gradually fell into ruin.

* In the early autumn of 1914 and simultaneous with the First World War, the Russians built the Maku railway. Actually it was an extension of the Trans-Caucasian Railway which starting from Shah Takhti Station in modern Armenia went through Iran for 150 km and passing through Maku and then

Bazargan border entered Turkey. One of the characteristics of the line was the short distance between its stations which was only seven kilometers. Also the width of the line was changeable from 1524 mm to the European standard of 1067 mm. The line went as far as the Euphrates River in Turkey but today no trace of its 150 km route inside Iran remains to be seen.

* Monsieur Khoshtaria the famous Russian contractor built a railway line between Rasht and Pirbazar Village with a length of 8.5 km in 1903. It was in service for many years carrying goods and passengers but when in 1936 its train was transferred to Tamishan of Mazandaran for shipping lumber, it was destroyed by fire (Pirbazar-Rasht route).

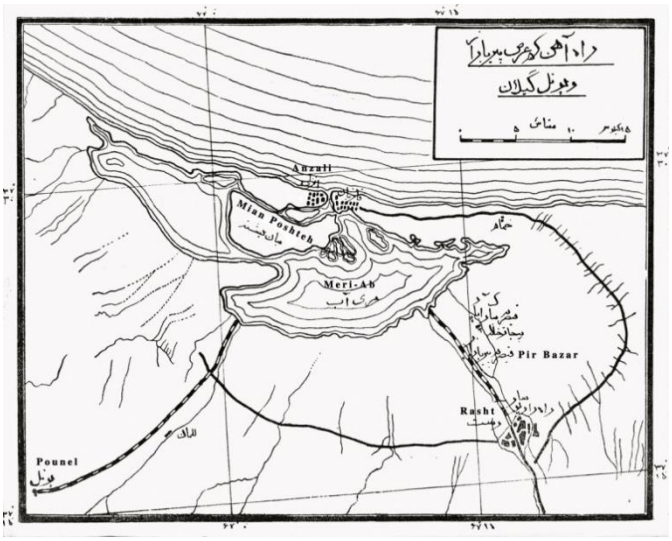


Figure 2.17: The railway of Pirbazar-Rasht;
Source: TIRRB Archive.

* In the years 1918-1919 Indian authorities built the Zahedan railway which extended 92 km into Iran and was actually the continuance of the Indian railway network. The line which had political reasons behind its construction originated from Ahmad-Abad of India and after passing through Nooshaki (in present Pakistan) reached Mir-Javeh at the border of Iran and terminated at Zahedan. The Eastern Indian Company and the British Empire were trying to have a secure corridor from India to Europe by extending this line to Bam, Kerman, Yazd, Naeen, Tehran, Qazvin and Rasht. From Rasht it was intended to reach Baku along the Caspian Seashores and after passing through Rostov of Russia and Warsaw of Poland it was supposed to terminate finally at the port of Calais in France. But political disputes led to the cancellation of the plan. The Nooshaki-Zahedan line became deserted around the year 1929 although after several years its reconstruction began again but it remained as a railway dead-end in the Iranian soil for a long time.

* In 1918 a 50-kilometer long railway was constructed between Borazjan and Bushehr by the English with only one daily passenger train

* The Anglo-Persian Oil Company built a railway line at its own expense and for its own purposes. Its major branch was between Darkhazineh and Masjed Soleyman with a length of 52 km.

* The total length of Abadan railway line was 104 km. It not only carried goods but also local workers.

* In addition to the above-mentioned short-term plans, more comprehensive plans were also on the agenda but all of them failed for one reason or another including the Saneeoldowleh plan as follows:

“Morteza Qoli Khan-e Hedayat aka Saneeoldowleh was educated at Europe in his adolescence. His father was the minister of the post in Naseroddin Shah’s court. After returning to Iran, Saneeoldowleh was appointed as the deputy for the newly-established Ministry of Mines. Later he became the chairman of the National Consultative Assembly where his railway plan was presented. In 1907 he wrote a book called “the Path of Rescue” in which he proposed the construction of a nationwide railway network using indigenous capital by taxing the sale of sugar, salt and tea. Saneeoldowleh believed that railway construction brought about national solidarity and cohesion but also knew that such a project would be extremely costly. Therefore, he suggested that the construction process should be performed in segments because when local people feel the positive benefits of railway with the passage of the time, they will voluntarily lend a hand.

Saneeoldowleh had drawn a sketch of his intended railway lines on the Berlin-published 1883 geographical map of Henry Kippert on a scale of 1:1000000. His drawing exactly overlaps present lines of the Trans-Iranian railway. His proposed routes were as follows:

Firstly: a railway line from Tehran to Mashad branching off from Shahrud to Gorgan aimed at the transportation of pilgrims

Secondly: The Tehran-Ahwaz railway passing through Qom, Soltan-Abad (Arak), Brujerd, Khorram-Abad, Dezful and Shushtar.

Thirdly: The Tehran-Jolfa railway passing through Qazvin, Zanjan, Mianeh, Tabriz and Marand branching off to Khoy and extending to Avajik in Turkey. From this point it was linked to Erzurum, Trabzon (on the Black Sea coast), Malatya, Kayseri, Ankara, Izmir and finally Istanbul on the Marmara Sea.

In order to put the plan into operation, Saneeoldowleh offered the parliamentary bill for taxing sugar and tea but it was rejected. Although twenty years later under the rule of Reza Shah Pahlavi, Saneeoldowleh’s project was fully executed. Political disputes and lack of governmental support for investment resulted in the failure of the plan despite its comprehensiveness during the Qajar rule.

In 1909 some of the renowned dignitaries of the time gathered to establish an Iranian company aimed at constructing the railway with domestic capital. They also set up a commission called “the Rescue” and presented a bill to the parliament urging the government to guarantee the investment in railway against unforeseen losses by establishing a national bank but this plan was also unsuccessful.

Picture 2.123: Photo: Saneeoldowleh;
Source: www.iranrailwaytourism.com

During the same period of time, the Potsdam Pact was signed between Russia and Germany resulting a more prominent role for the Germans in the Middle Eastern markets because from then on according to the deal they could deliver their merchandises to the region with the least possible delay using the Russian railway network. In contrast, British goods had a much harder path to reach target markets.

As a result, the British and Russian governments decided to build the grand railway network of India in order to curb German activities. Accordingly, in January 1911, they set up the "Railway Surveying Company of Iran" with the help of France but the first world war brought all operations to a halt. Albeit before the inception of the war, some works had already been done including the construction of the Jolfa-Tabriz railway.

Figure 2.18: Jolfa-Tabriz Railway;
Source: TIRRB Archive.

This was a brief history of endeavors for railway construction in Iran during the Qajar rule. The ideas of knowledgeable and high-minded men such as Mahdi Qoli Khan-e Hedayat and Saneeoldowleh as well as the Rescue Commission during the Qajar era were realized a few years later. It can be safely claimed that the Rescue Commission and the bill presented by it to the parliament was by far the best management plan of the Qajar era[19].

Although the idea of railway construction in Iran dates back to the Qajar era, several natural, political and economic problems prevented its realization. Irrespective of the adequate technology of the day, natural factors were less effective relative to political and economic ones. Generally, the most important factor obstructing the course of modernity in that era was the lack of funding. Although negative effects of the foreign policies of countries such as Russia and Britain must not be neglected.

As a matter of fact, only Hazrat-e Abdolazim and Mahmud-Abad railways were built in accordance with national interests of Iran; the former by Naseroddin Shah and the latter by Haaj Aminolzarb. All other lines were built according to specific foreign policy goals of alien countries particularly Britain and Russia.

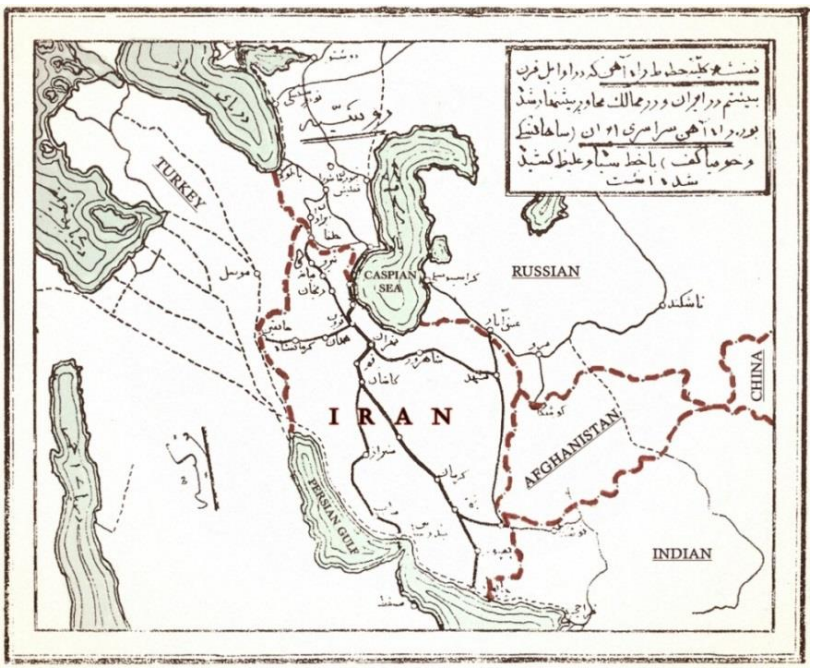


Figure 2.19:The proposed map of Trans-Iranian railway by Sahanski and Khomyakov;
Source: Mokammeli, 2000

[19] An assembly consisted of aristocrats and public representatives was set up and after lengthy consultations came to the conclusion that the construction of Iranian railway depends on public consent which can be obtained by proper state participation. In this regard the government must establish a national bank whose capital should be halved between people and government. The public share should be in joint stock and the state share should be guaranteed by the royal treasury.

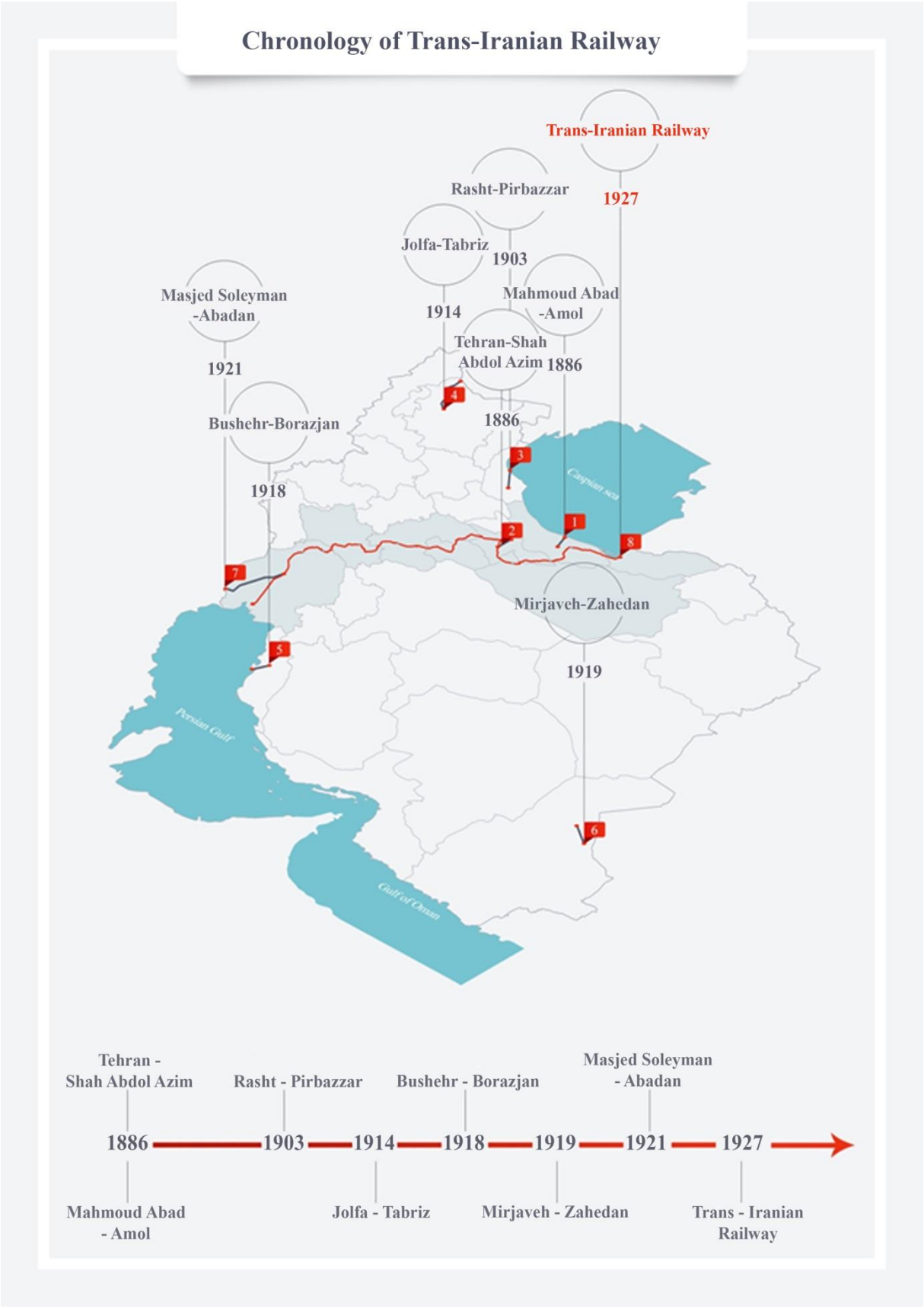


Figure 2.20: Chronology of Iranian railway (By: Meraj Sharifi).

The Trans-Iranian Railway

As for the above-mentioned problems, it seemed that construction of a Trans-Iranian railway network had become an unachievable wish. In his book "Mazandaran Travel Account or Memoirs of Reza Shah", the Shah writes:" linking the railway to the Caspian Sea and the Persian Gulf is one of my dreams. Is it possible to do this with an indigenous budget without seeking foreign loans under my supervision? Is it possible that the vast country of Iran would ever get rid of this disgrace? Is it…"[20]

But in the end, Saneeoldowleh's idea at the late Qajar period was realized exactly as he had planned i.e. using domestic capital by (granulated and lump) sugar taxation although it took a lot of time. On 1st Esfand 1926, the parliamentary bill for the construction of the Trans-Iranian railway was presented by Mahdi Qoli Hedayat the minister for public utilities to the National Consultative Assembly and was approved in 4th of the same month.

The Trans-Iranian Network

Late in 1925, Mokhberolsaltaneh Hedayat the minister for public utilities was commanded to set up a commission for the construction of the Trans-Iranian railway. The commission was consisted of representatives of all ministries under the supervision of engineer Hassan Shaqaqi who served as its manager. It aim was to estimate the costs of building a cross country railway from the Caspian Sea to the Persian Gulf. As a matter of fact, the royal order was the prelude to the issuance of the parliamentary bill mentioned earlier. The bill for the construction of the Trans-Iranian railway was the most important bill presented to the parliament in 1926sparking off heated debates.

In 1925, the initiation of surveying operations for railway construction was ratified. The Ministry of Road and Urban Development invited two American engineers by the names of: William B. Poland and Charles Josef Carl who worked as the head-engineer for surveying and his deputy respectively. They had full authority from the Iranian government and began their research on 1926. Deployment of Poland was recommended by Arthur Millspaugh who had selected one of his subordinates for this job based on the letters of certification for the good work of Poland. An American secretary had also been deployed for Poland and the nine American engineers acting as the first founders of the Trans-Iranian railway.

After the arrival of Americans, the "Railway Administration "was set up under the auspices of the Ministry for Public Utilities. Later, six surveyor groups with technical equipment were dispatched to northern and southern regions of Iran in order to launch preliminary investigations and to designate the best possible route. Following the elementary researches, Reza Shah summoned the minister for public utilities, Mirzayans deputy of Dr Millspaugh and engineer Poland. The Shah emphasized that every Tuesday a meeting must be held in the royal palace discussing the issue of railway construction. In these meetings the head manager of finance, Doctor Millspaugh, chairman of the railway, engineer Poland, an iron melting expert by the name of Monsieur Martin and some other foreign specialists held

[20] Memoirs of Reza Shah or Mazandaran Travel Account

regular talks in the presence of the minister for the Pahlavi Court, Teymur Tash. Moreover, Reza Shah had commissioned Martin to write a full report on the required iron consumption, the feasibility of importing an iron melting factory and its cost-effectiveness.

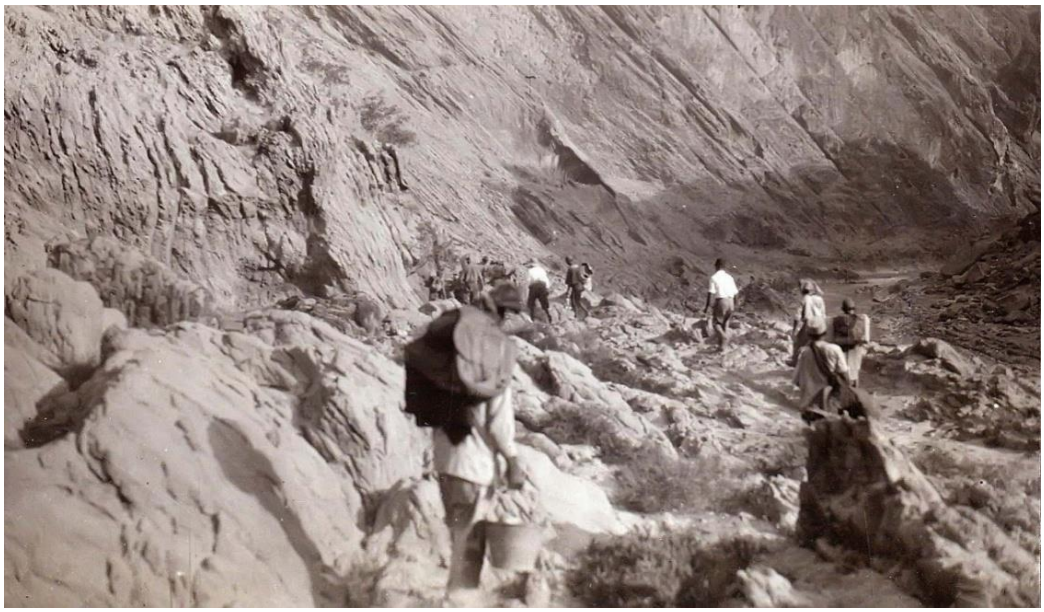
Consequently, the first team began studying the location of a seaport, measuring the depth of Khor Musa and Mohammareh (present Khorram-shahr) and surveying the southern terminal point of the cross country railway on the Persian Gulf shoreline in an area covering one thousand square kilometers. The second team engaged in the studying and surveying of the railway line from Khor Musa as far as Ahwaz and Saleh-Abad (present Andimeshk). The third team was send on a mission to study the terrain north of Dezful because at that point the Khuzestan Plain reached mountainous areas. Designation of a route from Dezful to Brujerd needed precise studies which were done by three surveyor groups. At last, the route passing through Abdiz valleys was chosen because it was considered as a shorter and more economic route for a railway line.

Picture 2.124: Difficult operations Identify the route by crossing the river;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.125: Access roads for the construction of railway;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.126:Transportation of various materials for the construction of railway;

Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).



Picture 2.127: Difficult process of identifying the route;

Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.128: Some activities related to identifying the route;

Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

The fourth team embarked on studying the northern route passing through Rey, Varamin, Ivanaki and Qeshlaq as far as Alborz foothills. The specified route was subsequently mapped and surveyed. The fifth team was given the task of mapping and surveying a hypothetical railway line from Semnan to the coastal plain of the Caspian Sea through the Alborz mountain ranges. Later the team was forced to study all the routes existing between Shahrud and Gorgan due to the presence of hard and soft lands and the necessity of passage through forests and mountains. But because no appropriate route or mountain pass was found for a railway line, the team returned to Firuzkuh and after mapping Talar riversides in Firuzkuh pass reached the conclusion that west of Talar River was the best track. Finally, the sixth team was tasked with triangular mapping, measuring the surface of coastal points of the Caspian Sea, evaluating sea depth in Bandar-e Gaz and weighing the potential of various locations in order to choose the best northernmost sea port at the end of the railway network. The team covered an area of about 250 square kilometers plus an area located within Ashraf Plain.

Preliminary operations of railway construction had been already done by the Railway Administration of Iran but during the operational phase it was found out that there was a shortage of expertise, equipment and experience to do the job in an efficient and cost-effective manner. Therefore, in Khordad 1926, the Railway Administration of Iran was disbanded and replaced by a small group called the Inspection and Supervision Board consisting of: Carol, Terskinski, Kasakowski as well as Diba, Banan, Vakili, Moshaver, Davari, Pakdaman and Hosepian from Iran and headed by Ezzatollah-e Hedayat, son of late Saneeoldowleh. As a result, railway activities came generally under the control of a syndicate of foreign engineers and experts so that individual contracts of Poland and others were cancelled; instead they had the right to continue their work under the auspices of the syndicate.

In the meanwhile, it was decided that railway construction must be funded by sugar and tea taxation according to the ratification of the parliament. Before the start of construction activities, the government had already made the law for sugar and tea exclusive taxation which was approved by the National Consultative Assembly on the 9th day of Khordad 1925. Under the law 2 Rials of tax must be leveed for every 3 kg of granulated or lump sugar and a 6-Rials tax must be paid for every 3 kg of tea. All such revenues were spent for building the cross country railway network of Iran.

The Process of Formation and Designing of the Trans-Iranian Railway

When it was realized that the dream of railway construction was finally on the verge of materialization, all previous plans were seriously taken into consideration. Subsequently, widespread investigations were launched in order to pick the best plan in line with national interests. Finally based on the following priorities, it was decided that the railway line should began from the eastern coast of the Caspian Sea and end in the western shores of the Persian Gulf[21].

First of all, irrespective of its huge benefits for trade expansion, increase of public wealth and its strategic aspects, access to open seas is also crucial for railway construction because of the need for the delivery of a large amount of heavy equipment such as: rails, wagons, locomotives, machineries etc… land delivery not only is more costly but also is much slower because it must be done through several countries sometimes requiring time-consuming bureaucracy related to customs clearance, etc.... Instead starting the construction from a point on the southern seashore greatly facilitated the operations because with the continuance of works, construction materials and equipment could be easily delivered by the newly-built railways causing a large saving in expenses.

Secondly, the Trans-Iranian railway from south to north passed through all developed areas, major cities and farmlands; in this way delivery of foodstuff and goods required by central parts of the country became feasible from north and south which are among the most fertile regions of Iran. Therefore, the priority was given to a northern-southern cross country railway line.

Thirdly, on the whole this route was more cost-effective relative to other routes because despite the presence of numerous natural barriers, other routes were not only more cumbersome but also longer and costlier than this one. In addition, the national security was better guaranteed with this plan.

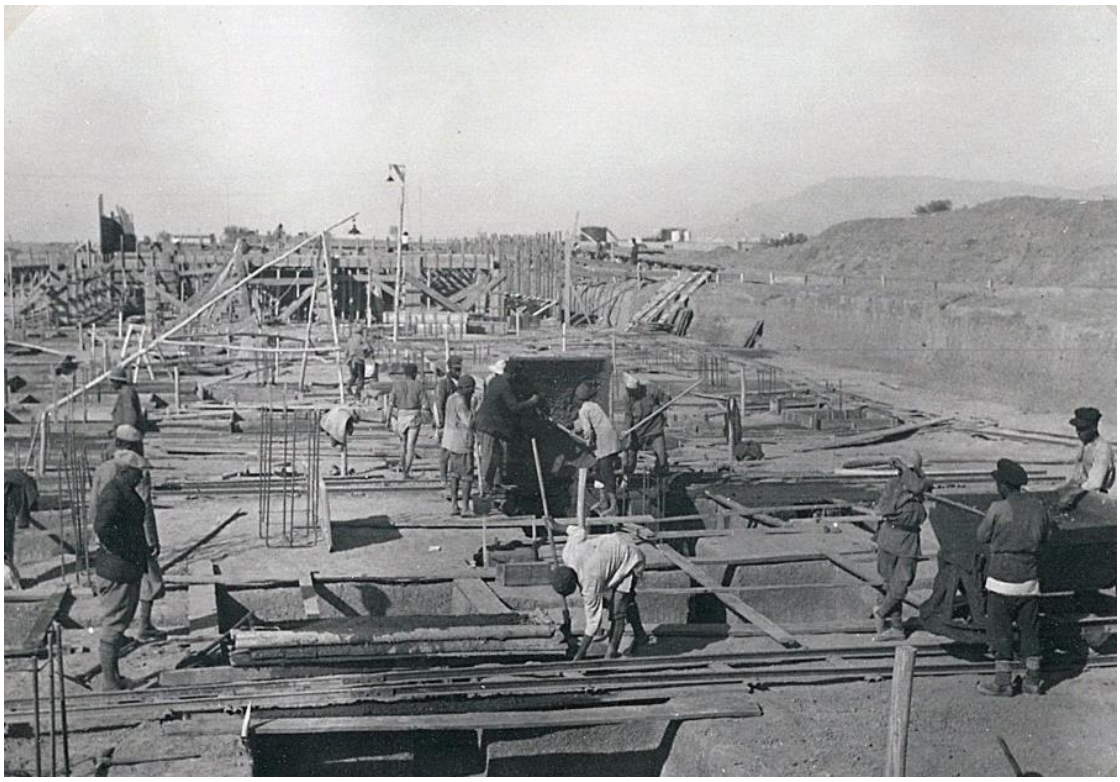
By and large, the final plan of the Trans-Iranian railway consists of a long main line linking the northern seashores to southern coasts of the country. Bandar-e Shah[4] was designated as its northernmost end and Bandar-e Shahpur[5] became its southernmost end. Arrangements were made to start construction operations from both directions extending them towards inland. As a result, the line was divided into two parts called the northern and the southern lines respectively. The former had a length of 461 km linking Bandar-e Shah to Tehran and the latter with a length of 933 km connected Tehran to Bandar-e Shahpur. The total length of the cross country line amounted to 1394 km.

Actually the trans-American railway was also built by starting the construction operations from seashores and gradually advancing inland and delivering the required materials and equipment by the newly-built railway. This is called the “American method” which was also exactly imitated in Iran.

[21] In this regard, Engineer Terskinski writes this in the “Brief History of Railway”:” In the commission about the preliminary phase of the Trans-Iranian Railway, representatives of the Ministry of War insisted on the passing of the railway line through Khorram-shahr, Ahwaz, Dezful along Karkheh and Kashkan rivers, then through Khorram-abad, Brujerd, Malayer, Hamedan, Qazvin and Tehran. They highlighted the military advantages of the route. But various projects were studied and discussed with the presence of all ministers in 1926.”

After the culmination of the preliminary operations of zoning and mapping in northern and southern regions of the country, preparations were made for the start of construction activities. In 1927, The king of Iran delivered a speech on the occasion in front of a group of ministers, dignitaries, parliament representatives, ambassadors, military commanders, media managers and other people who had been invited by the Ministry of Public Utilities to gather in Hussein-Abad site at Gomrok Gate. Afterwards, amid the sound of cannonballs Mokhberolsaltaneh, the chief minister and the minister of public utilities handed a silver pic to the Shah who initiated the construction of the Central Railway Station on grounds outside of Mahmudieh Gate. The event heralded the beginning of the infrastructural works for the cross country railway line.

Simultaneously, in Bandar-e Gaz and Ahwaz as the northern and southern headquarters of the Trans-Iranian Railway, opening ceremonies for construction works were held and operations began simultaneously at all three construction sites on northern, central and southern parts of the planned line. The first group consisting of one hundred workers operated in the southern site but a few days later their number increased to 1600. The second group worked in Tehran numbering 100 which was increased to 300 a few days later. Also a 67-strong workforce started operation at Bandar-e Gaz site heralding incessant construction activities until the completion of the project.



Picture 2.129: Construction of Tehran station;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

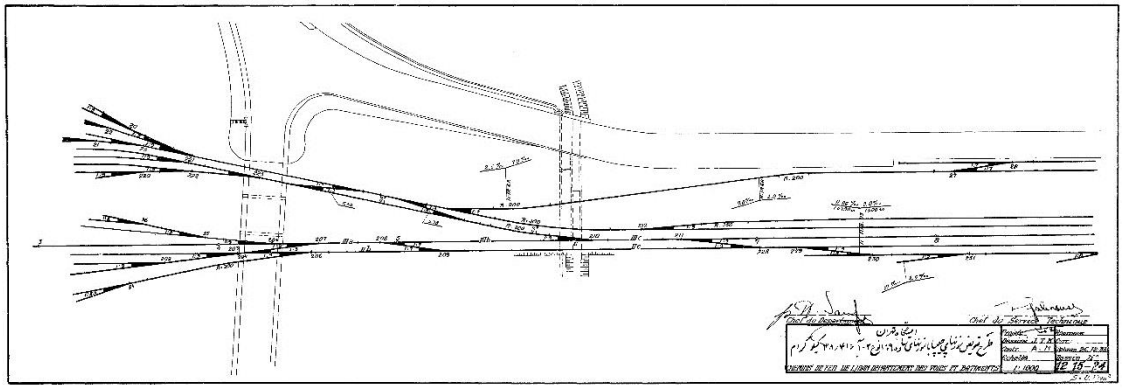


Figure 2.21: Tehran station construction.
Source: TIRRB Archive.

Picture 2.130: Construction the railway along the northern region;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

In the meantime, the Railway Administration continued studying rivers of Khuzestan and drew blueprints for the new dam and bridge of Ahwaz. Among other activities of the Administration mention can be made of: putting various operations out for tender during a two-year period of time 1926-1928, technical inspections of a 2345 km route in order to designate the best path possible for the railway, preliminary mapping of the whole 1513 km length of the line, final mapping of 336 km of routes in the north and the south, carrying out research at coastal waters north and south of Iran, preparing pertinent topographic maps, complete leveling and earth filling of 158 km of routes in the north and the south, mapping and continuing preparatory activities at Tehran station.

1- Present Bandar-e Torkaman
2- Present Bandar-e Imam Khomeini

The Ministry of Road and Urban Development began studying and surveying the northern line in 1927 but its finalization was handed over to a German company after one year despite the fact that an experimental map had been prepared. Until 1930, the German company completed the mapping of the northern line from former Bandar-e Shah to Tehran. Moreover, it prepared 127 km of the line located in Mazandaran plain for utilization. At the beginning of the operations, shortage of required equipment and absence of expert workforce could delay the project but with the passage of time the strong determination of railways authority prevented this from happening.

After the preparations made by the Railway Administration, practical phases began and arrangements were made to complete the project at the least time possible and at a modest cost. Therefore, in order to expedite the executive stages, tenders were put up in foreign countries and the ground for the formation of the Railway Syndicate was paved.

Mappings and Preliminary Stages

As for the absence of detailed maps of terrains through which the railway line was to pass, the Syndicate itself had to draw a comprehensive map. But beforehand, studies were conducted for exact specification of the railway route again. This time, surveying engineers did the job also on foot. At those places where cars or horses could be used, operations were performed faster but at impassable points airplanes were used in order to select the best route for connecting cities and stations. The syndicate wanted to pick a terrain which not only was cost-effective but also had a firm soil from a geological point of view. At the steeply-sloped spots, the land was marked with furrows. Generally, flat terrains were mapped using Geometry method but harsh terrains were mapped using the Aero-photogrammetric Method i.e. taking pictures from an airplane.

Several groups of surveyors were tasked with preparing Nakometric maps. Each group was consisted of three engineers or four technical staff, one accountant, one interpreter and 25-30 porters for carrying tents and other equipment. A car driver, a cook and a police officer completed the team which along the way made stopovers at towns and villages or in tents.

Picture 2.131: Crossing the Sezar river for route construction;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Land plots were surveyed at a width of 300-500 meters and maps were prepared on a scale of 1:2000 but a scale of 1:4000 was used for flat terrains. Surveying teams were also tasked with gathering necessary information on the terrain type and the availability of construction materials such as stone, sand and water along the line. Moreover, they made suggestions about the number of spans, the type of bridges, abducts and other technicalities and sometimes full maps were also annexed to the dossiers. The progress of groups very much depended on the type of terrain to be mapped. According to statistics, in harsh terrains only five km could be covered per month but in smooth terrains a monthly 30-40 km of progress was feasible.

After the preparation of the maps, the head of surveyors drew a sketch of the general route and after annexing it to the sectional map (line tachometry) sent it to the central administration in Tehran for final confirmation.

Afterwards, the ministry tasked another group for final operation of the line. Among other jobs of the group were: providing the route details, the location of bends, leveling of the course, marking the roadbed, marking the path axis, preparing and drawing widthwise and lengthwise cross-sectional as well as other maps needed such as those pertaining to technical structures.

The monthly workload of a pegging team was almost equal to that of a tachometry survey team. The German mission preferred aerial photography for an initial study of the line and for preparing the complete map of the northern segment including Talar and Hablehrud valleys.

For this it used an airplane equipped with vertical photography instruments and other specialized tools. In order to have an appropriate triangular reference, a triangle was drawn on the ground and the soil underneath was leveled. The triangle served as a source for specifying future routes and determining mapping directions. Later due to the density of forest at the lower part of northern foothills, aerial photos were not adequate therefore in order to obtain terrain details, the German mission inevitably had to resort to tachometry in forests.

Despite the fact that the Railway Syndicate was in charge of contracts made with the government, companies volunteering to participate in building the Iranian railway were in fact various foreign companies comprising a syndicate of their own.

Gradually the news about the Iranian railway construction reached all over the world. Particularly tenders regarding the purchase of railway equipment attracted the attention of foreign investors and companies. As a result, most of them began to send their representatives to Iran with their proposals.

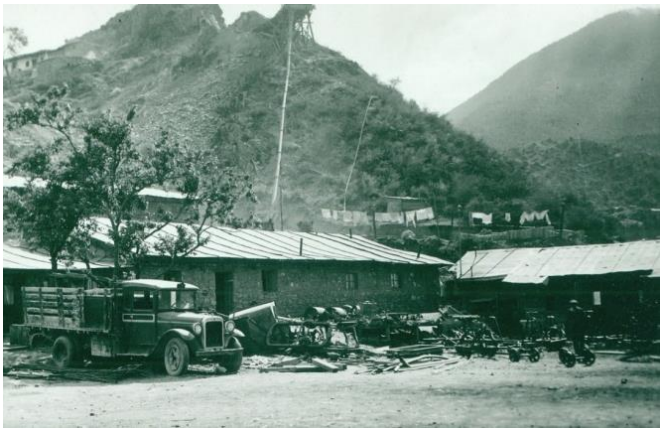
They not only intended to sell specialized instruments but also wanted to win contracts for mapping and building purposes.

At last proposals coming from an American firm called Ulen as well as three German companies of Philipp Holzmann, Julius Berger and Siemens Bauunion were accepted. Based on the law approved in 1928, the Iranian government signed a deal with the above-mentioned companies which had created a syndicate. It was decided that the complementary phase of railway mapping be entrusted to the syndicate besides the construction of a 150-km segment in the north and another 150-km section in the south. It should be reminded that the expert members of this company recommended Bandar-e Shah (present Bandar-e Torkaman) which replaced Bandar-e Gaz as the northernmost tip of the railway network due to its deep sea and its being sheltered from winds and waves. Because this made the docking of big ships much easier.

The first ship carrying a cargo of railway equipment including bridge-building machinery and 20000 meters of iron sleepers bought from USA reached Khor-Musa in 1928.

As said earlier, the Iranian government recognized only the syndicate as its contract party but the syndicate had to distribute the tasks among its partners in order to expedite the operations. Later, German companies oversaw the northern line operations and the American company began working in the south. After the finalization of the mapping and surveying of various lines, the governmental ratification was sought. In the end it was agreed to start the line from Bandar-e Shah and after passing through Firuzkuh extending it to Tehran plain. Further on, the line went through Soltan-Abad and Ahwaz via Abriz straits and ended in Khor-Musa.

According to the contract dated in 1928, in addition to completion of the lines mapping and construction of experimental (test) lines, the syndicate was charged with the task of: completing the construction of a 150 km line remaining from former contractors (previous Railway Administration) in the north and the south, construction of docks for the northern and southern terminal ports of Bandar-e Shah and Bandar-e Shahpur respectively as well as building a bridge and a dam in Ahwaz. Initially, the mapping of different segments of the Trans-Iranian railway was finished. As mentioned before, the line was to begin from Bandar-e Shah and going through Firuzkuh and Tehran plain reached Ahwaz via Abdiz strait and ended in Khor-Musa. On the northern line, railway authorities had already designated Bandar-e Gaz as the railway port of the north initiating earth-filling and line-building tasks but syndicate officials disqualified the location following detailed researches and agreed upon a spot 22 km more to the north at the present location of Bandar-e Torkaman due to its higher sea depth and its being protected against strong winds and waves; these factors contributed to an easier cargo-carriage by ships. Therefore, this strategic point was selected as the northernmost port of the railway network. The German part of the syndicate proceeded to link Bandar-e Shah (present Bandar-e Torkaman) as far as Qaemshahr (Shahr-e Shahi) with a length of 127 km within the specified period of time. On this route, earth filling, sandblasting and track-laying was finished and all the buildings required including train stations and quarters for railway workers were constructed.

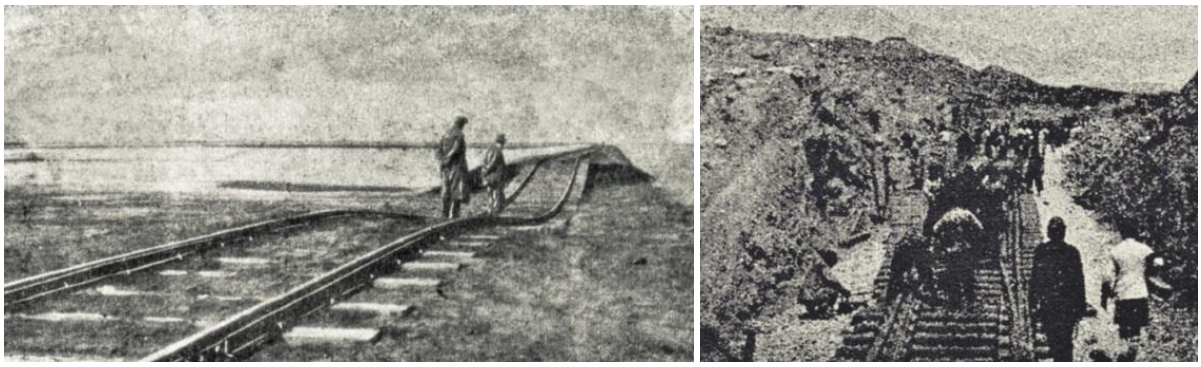


Picture 2.132: Workshop equipment along northern route.
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

On the southern segment, the American party of the syndicate built a wooden dock for Bandar-e Shahpur (Bandar-e Imam) and after the completion of the embankment half-built by former contractors (previous Railway Administration) laid down tracks on the remainder of the line as far as Saleh-Abad at a length of 250 km. Furthermore, the Karun Bridge was constructed, preliminary studies about the construction of Ahwaz dam began and the pertaining maps and documents were sent to the capital. But the performance of Americans did not satisfy state authorities of the time because earth filling and sandblasting activities had not been done properly and tracks had not been laid in a standard manner. Moreover, at some points protective measures such as stone-laying and digging of waterways was lacking leading to the destruction of a large section of railways near Ahwaz during the torrential rain of 1929 which caused the flooding of Karkheh River. Additionally, due to the low quality of construction materials used at Ahwaz stations and its yard buildings, the health of activities in the southern branch were questioned by the Supervision Administration as well as by governmental engineers resulting in the ultimate cancellation of American contract and the stoppage of all operations in this part. Later two neutral engineers from Belgium (Louis Vander Holst) and Japan (Suzuki) were invited in order to investigate the reason for Karkheh flooding and the general function of the American company.

Once in the south, engineer Vander Holst embarked on a comprehensive investigation about the fourth geological age and came to the conclusion that formerly in the north of the region and behind a series of cliffs, there was a lake on the route of Karun and Karkheh rivers but with the passage of time the lake vanished and the cliffs were leveled because of erosion. In fact, between the years 241-271 AD, King Shahpur I built a dam at this point which was rebuilt by Tamerlane several centuries later but did not last long and collapsed again. In his report, Vander Holst writes that the region through which the southern line passes had previously been a sea into which Karkheh and Abdiz rivers flew. At present the railway line goes through a riverbed which used to be the course of both rivers. This puts the railway line in grave danger and makes its maintenance difficult. Therefore, railway engineers should have taken necessary precautions against seasonal inundations and by taking into consideration the possible flood course, the railway line could have been saved. Also Vander Holst suggested that the line should pass through Shushtar which is out of the range of the flooding. About the performance of the American company, Vander Holst reported that earth filling, track laying and earth moving activities have been done carelessly incurring unnecessary costs. At the same time, he reported that in

contrast excavation operations at an 11-km stretch of Bandar-e Imam had been done quite adequately and cost-effectively despite the presence of a large amount of soft mud. Moreover, track laying of the southern branch had been entrusted to an inexperienced engineer whose negligence has led to the widespread damages incurred in 1929 after the flooding in north of Ahwaz. But according to the report the American company had generally tried its best and its performance was more or less satisfactory.



Picture 2.133: Damaging the route by flood, 1929;
Source: TIRRB Archive.

As a consequence, because of the damages incurred to the project, the contract with the American company was annulled and the Syndicate was dissolved but as for the good performance of German companies and the unfinished operations of the northern line, a separate contract was signed with them on behalf of the government. Finally, in 1931, complementary operations on the northern line were finished and the last segment extending from Bandar-e Shah (present Bandar-e Torkaman) to Qaemshahr (Shahi) with a length of 127 km was brought into operation.

After cancelling of the syndicate contract, the government took control of the construction activities and deployed a number of Swedish engineers to finish the remainder of the northern line from Qaemshahr (Shahi) to Tehran. The southern line was also entrusted to an American engineer called Carol. Swedish engineers worked for two years on the northern line and managed to level and excavate as far as 285 km away from Qaem Shahr. Also they prepared the ground for the construction of Gaduk tunnel. But did not finish the construction of train stations and workers' quarters. Later a company by the name of Kampsax was put in charge of operations. Carol embarked on an essential reconstruction of the southern line left unfinished by the former syndicate. Additionally, all the flood damages within a 160 km distance of Ahwaz were repaired and 50 km of new railways were added to the 350 km railway line already built by the disbanded syndicate.

Continued Construction of the Cross-country Railway on the Southern Axis

As pointed out earlier, by the time the syndicate was ousted, the southern line was not in good shape because the wooden bridges built by the syndicate at inlets near Bandar-e Shahpur (present Bandar-e Imam) were all in constant danger of being washed away or subsiding; also they had a poor quality. But after the deployment of the new mission headed by Carol, within a period of two years fundamental repairs and reconstructions were done costing millions of Rials. Carol and his team

inevitably filled the inlets with earth and stone turning them into hard and firm grounds so that the railway embankment would not subside. Furthermore, they consolidated all pillars of wooden bridges with iron or concrete and after repairing flood damages between Ahwaz and Andimeshk at a distance of 160 km, constructed higher-quality buildings.

Moreover, they laid tracks on the 50 km route prepared by the Syndicate north of Saleh-Abad (present Andimeshk) resulting in the formal opening of the railway running from Bandar-e Shahpur (present Bandar-e Imam) to Saleh-Abad (present Andimeshk) in 1932.

The Kampsax Consortium

Operations ran smoothly both in northern and southern plains of the country due to the existence of a flat terrain. But as of early 1933 both lines entered mountainous areas greatly slowing down the operations. In the north the high straits of Alborz as well as the Firuzkuh peak and in the south, the Zagros mountain range as well as hardly-accessible straits of Abdiz valley hindered any progress. As a matter of fact, the most difficult and costly part of the cross country railway of Iran was confronted in this year. Not only in Iran but also in other parts of the world these terrains are considered quite problematic for railway construction.

Following the annulment of the Syndicate's contract, a Danish company by the name of Kampsax volunteered to take part in the Trans-Iranian railway tender. It had already finished the construction of a long railway line in Turkey and its work had been deemed satisfactory by the Turkish government concerning both the quality and the quantity. Afterwards the Consortium presented a proposal to the Iranian government which seemed reasonable particularly because it came from a country which posed no risk to the sovereignty of the nation. Later in 1933, a contract was signed between the government of Iran and Kampsax Consortium in which Kampsax was appointed as the technical consultant and representative of the Ministry of Roads. Also they gave an undertaking to procure all the necessary equipment for completing the remaining part of the Trans-Iranian railway which had an estimated length of 1000 km. According to the contract it was agreed that Kampsax must complete the plan until early 1939 (4 years for the northern branch and 6 years for the southern branch) and hand it over to the Iranian government.

One of the reasons for Kampsax to win the contract was political because the Swedish-Danish company belonged to neutral states with no colonialist or exploitative background in Iran. Therefore, the government entrusted the continuance of railway construction to Kampsax in 1933. The first four letters of the word Kampsax was in fact an acronym of the names of three founders of the company and its last three letters was an abbreviated form of Yurgen Saxild, the name of its Danish manager.

Picture 2.134: SAXILD, head of Kampsax company;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

As a matter of fact, Saxild was the head of an efficient group of personnel. He was directly in constant contact with Reza Shah and the two men felt a mutual respect and trust for each other; this made things easier and faster because royal orders solved any potential obstructions.

In order to advance the project, Saxild summoned a team of experienced engineers from Europe such as: Harry Haklin, a Swedish surveyor, Hans Nutter, an engineer from Switzerland who was an expert at tunneling and Ladislav von Rabsovich who was a specialist at bridge building coming from Austria. The Consortium also included Nohab Company which built and maintained locomotives and wagons.

Briefly the contents of the contract between the government of Iran and the Kampsax Company was as follows:

1- Acting as the advisor for railway construction from Bandar-e Shah (Bandar-e Torkaman) to Tehran and from Tehran to Andimeshk, the Kampsax Company was charged with the duty of executing all preliminary operations, putting its facilities at the disposal of the Ministry of Road and Urban Development and putting required equipment into operation.
2- The organizational structure of Kampsax was comprised of a central administration office, a technical bureau in Tehran, an accounting branch and a purchase unit.
3- Kampsax undertook the task of performing the entire construction activities using state of the art technology while accepting the final responsibility for the quality of works.
4- The government of Iran pledged to pay five gold dollars (one gold dollar equals 1.50463 gram of pure gold) in lieu of every meter of railway built
5- The company had the right to subcontract various parts of the project to other companies by putting them out for tender
6- Kampsax accepted the responsibility for the performance of these subcontractors.

7- It undertook the task of completing the construction of all the buildings affiliated to the Shahi (Qaemshahr)-Tehran line within 4 years and the Tehran-Andimeshk line within 6 years
8- Kampsax was committed to submit a monthly report on work progress to the Ministry of Road
9- The government was committed to give sufficient guarantee to Kampsax concerning the construction rights
10- The government reserved the right to demand a 75000-rial compensation for every week of execution delay
11- The contract was valid for six years
12- Any possible dispute was to be settled by an arbitration court

Kampsax started its operations from 1933 in northern Iran. In 1934, the entire route was divided into 43 lots and 40 Iranian or foreign companies undertook the project by winning tenders deploying a workforce of more than 65000 engineers, office personnel and laborers. On the Alborz segment of the northern line, most of the contractors were Italians and workers had Italian or Turkish nationalities. On the Zagros segment of the southern line, most of the contractors were British. Of course many Iranian workers were also employed on both lines.

Out of a total of 43 constructional lots provided by Kampsax, 23 lots were on the northern line and 20 lots belonged to the southern line.

On the whole, the route covered by Kampsax from Bandar-e Shah (Bandar-e Torkaman) to Bandar-e Shahpur (Bandar-e Imam) had a length of 1394 km of which a 157-km stretch on the northern line and a 169-km stretch on the southern line traversed rugged or mountainous terrain. Despite all the difficulties, Kampsax managed to complete the following projects

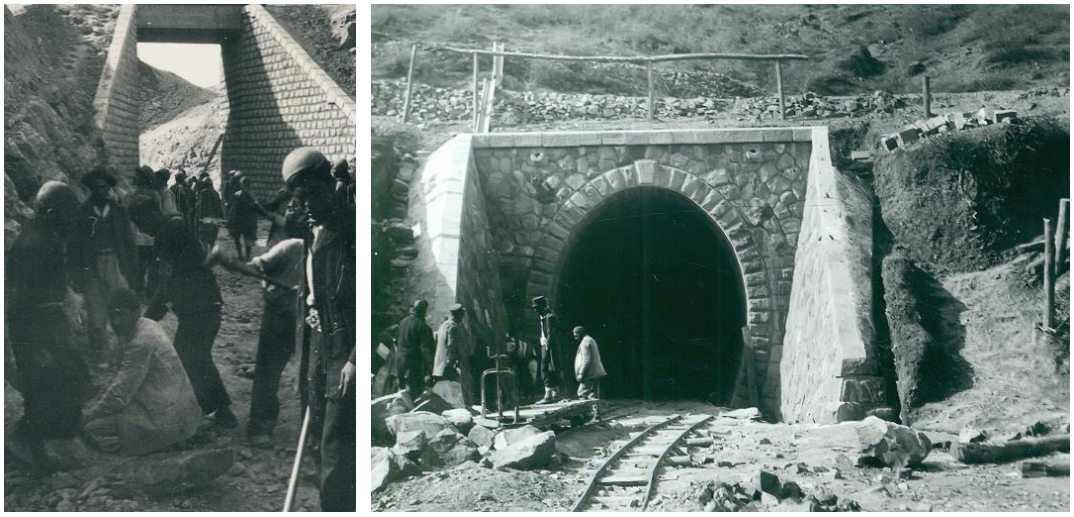
-224 tunnels totaling a length of 83.666 km

-4100 bridges with a total length of 22 km

-2.3 million cubic meters of masonry work

-28 million cubic meters of earth filling

At the climax of operations 45000 laborers, 5000 artisans and 450 engineers or technicians were at work along the line.

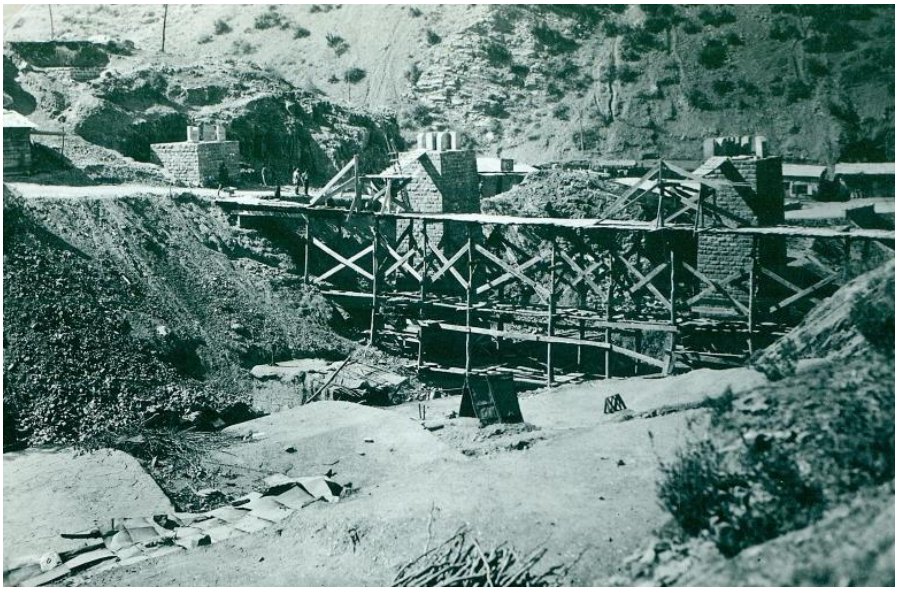


Picture 2.135: Route construction,1929;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

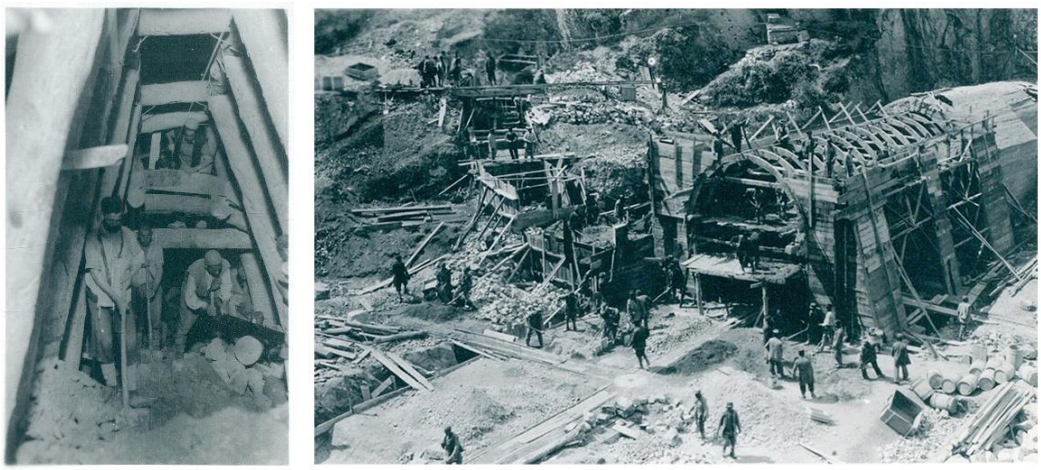
Picture 2.136: Railway route construction,1930;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

The main four reasons contributing to the success of the Trans-Iranian railway project were: the strong will of the Iranian government authorities, timely provision of financial resources, efficient organization of the project and the offering of effective solutions during difficulties and emergencies.

In the meantime, ordinary people also played a vital role in this achievement because the central government funded the project by taxing the consumption of tea and sugar and this proved to be acceptable and reasonable for the public.



Picture 2.137: A bridge under construction along northern region/ Dogal – Veresk;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).



Picture 2.138: The route under construction, 1929;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

The Cost of Trans-Iranian Railway Construction

Under the legislation ratified in 1925, aimed at the construction of the cross country railway of Iran, a 2-rial tax on every 3 kg (granulated or lump) domestic or imported sugar and a 6-rial tax on every 3 kg tea was levied. It was intended that railway construction must be completed without any sort of foreign borrowing.

Here comes a brief review of revenues received from tea and sugar taxation between the years 1929 and 1941. In fact, the taxation was in force right after the ratification of the law in 1925 but statistical data about the annual income are available only from 1929onwards.

On the whole, as the money gathered for the completion of the railway network was not sufficient even after the tea and sugar taxation, the government was forced to take a loan of 370 million Rials from domestic sources such as the national and the agriculture banks. Of course the entire amount was paid off in 1947.

Revenues from Sugar and Tea Taxation

The amount of loans paid by local banks was as follows:

-150 million Rials from the National Bank of Iran in 1935 with an interest rate of 2% for the first year and 4% for the following years

-70 million Rials from the Agriculture Bank in 1935 with an interest rate of 3% for the first year and 6% for subsequent years

-60 million Rials from the National Bank of Iran in 1936 with an interest rate of 6%

-90 million Rials from the National Bank of Iran in 13937

Total sum: 370 million Rials

Aside the revenues coming from taxes and bank loans, railway incomes and money from other sources were also spent for construction purposes. Here is a brief account of the money allocated to the project from 1925 onwards in which the exclusive law for tea and sugar taxation was passed and enforced until the end of 1938. As mentioned earlier the project was funded by: tea and sugar taxation, national reserves, current income and bank loans. Also a list of budget expenditure according to special laws until the end of 1938is seen.

The Second World War and the Role of Iranian Railway

At the start of the WW II in 1941, Iran was occupied by allied forces. The Second World War began in September 1939 and ended in August 1945. One day after the start of the war the Iranian prime minister announced the neutrality of the government and asked all the foreign nationalities residing in Iran to avoid the expression of any feelings in contrast with this state of neutrality.

But in 1941, the allied forces (the USSR and the Great Britain) invaded Iran disregarding the state announcement and managed to occupy the entire country quickly. Main aims of the occupation were: to gain access to Iranian roads in order to supply Soviet forces, utilization of its oil resources, expelling of German experts and citizens to foil the possibility of a coup by Nazi sympathizers as well as preventing them from usage of Iranian oil wells and roads. Additionally, the possibility of confrontations in case of the German Army approaching Iranian borders was taken into consideration.

In an official note submitted to Iranian authorities, Soviet and British ambassadors pointed out that the incentive for the invasion was the presence of a sympathy for Germany in the foreign policy of Iran.

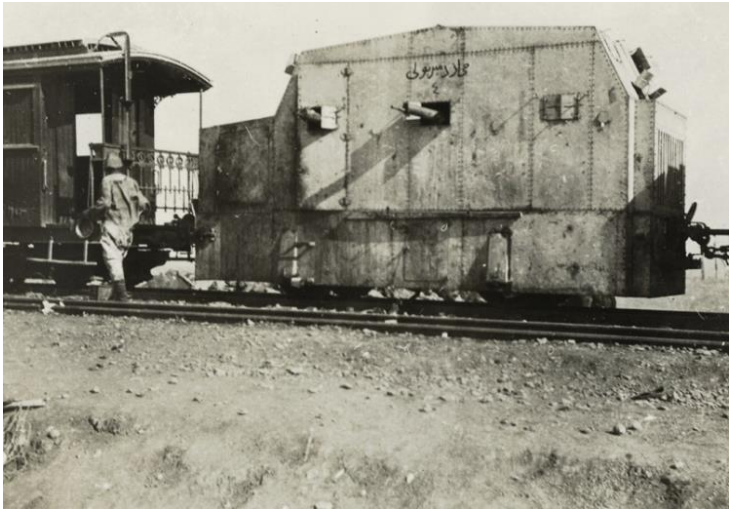
Picture 2.139: The army camp near the railway route/1942;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Picture 2.140: American and British soldier trainmen, somewhere in Iran;
Source: Library of Congress; The Crowley Company; American photographer: Nick Parrino, www.commons.wikimedia.org

Ali Mansur the prime minister of the time began negotiating with Soviet and British representatives but as no positive result was produced, he announced his resignation because of his incapability to run state affairs and was replaced by Mohammad Ali Forughi (Zakaolmolk). At the same time, all major traffic routes of the country in particular railways and asphalted roads were under the strict control of the occupation forces. Additionally, the Iranian workforce were deployed in the railway section and other places in order to provide logistical support for allied troops.

Consequently, oil resources of the country dwindled and the food crisis and public poverty reached a peak. Moreover, the monetary policies of Iran were totally influenced by expenses incurred due to the presence of foreign armies as well as the need to provide aid for the Soviet Union.

The question is: what was the real reason behind the usage of Iranian roads and railways by Russian and British troops? As a matter of fact, the then Soviet Union was a vast country covering not only eastern and northeastern Europe but also whole of the northern Asia. But all of its sea routes were either under the control of Nazis or unusable. In addition, some of them became frozen in wintertime. As a result, the attention was turned to countries existing to the south of the USSR with access to open seas such as Iran, Turkey and China. Turkey was the nearest country to the USSR and not only had easy access to high seas but also had a well-developed asphalted road and railway system which could be used to carry food and ammunition. But it could be easily bombarded by the axis forces. China was in contrast too far from war fronts and was threatened by Japanese forces. Therefore, Iran was considered an ideal route because of its strategic position as it was located outside the range of Axis airplanes and could be regarded as a safe and speedy route. In particular, its railway network was of great importance. Moreover, the relatively mild climate of Iran made possible the supply of food and ammunition almost all year round. As a result, the allied forces began to carry foodstuff and ammunition to Khorram-shahr and Shahpur ports in the south and using the domestic system of roads and railways, transferred them to depots and yards built adjacent to Andimeshk, Shahrud, Mianeh, Qazvin, Karaj, Tehran, Shahi and Bandar-e Shah train stations. A large area around each station was occupied by Allied forces in order to accommodate soldiers and storage of food, ammunition and armaments without paying any rent to the Iranian government.



Picture 2.141: Trains Iranian Railway during the WW II /1943;
Source: TIRRB Archive.

During the WWII and the Anglo-soviet occupation of Iran aimed at helping the Red Army against Nazi Germans, the government of Iran made the following contributions to the war effort: provision of transportation vehicles, provision of oil, fuel, ammunition and weaponry, putting military and non-military facilities and factories at the disposal of the Allied forces, providing foodstuff and other necessities, issuance of official permits for using port and aerial facilities, public and private buildings, telephone and telegraph lines as well as making available human resources such as: experts, engineers, drivers, civil servants and laborers.

But by far the most significant contribution of Iran was the usage of its traffic routes especially its railway network.

The railway lines most frequently used by the Allied forces were those from: 1- Tehran to Zanjan 2- Tehran to Shahrud 3-Tabriz to Jolfa 4-Zahedan to Mir-Javeh 5- Ahwaz to Khorram-shahr 6- and especially the cross country line from Bandar-e Imam to Bandar-e Torkaman

Picture 2.142: Occupation of the Trans-Iranian railway line by Allied forces, American, Russian and English engineers in the cab of an engine. Each of them has done his part in hurrying supplies route to Russia along a railroad in Iran;
Source: www.parstimes.com

Therefore, it can be safely concluded that the Iranian railway played a vital role in the victory of the Allied forces over the Nazi army. At the beginning of the railway utilization, an average daily amount of 500-1000 tons of ammunition was carried. But after the addition of new locomotive wagons, the weight of such cargo reached as high as 11000 tons a day in the middle of 1944 which was unprecedented in the history of transportation the world over.

In 1941, a total of 80 locomotives were in service but in 1944 the number was increased to 3500 locomotives. After the end of the war, some locomotives were returned to the owner countries but some were sold to Iran. In 1941, the Iranian railway had 1993 usable wagons which reached the number of 7793 wagons in 1944. Due to the lower price of wagons relative to locomotives and their higher volume, almost all of them were sold to the Iranian government. As expected these locomotives and wagons had been highly depreciated during the war and were in a poor condition.

The 35000-strong workforce of the State Railway Institute of Iran was mainly consisted of workers and civil servants who were active around the clock in order to deliver the necessary shipment to the USSR. The fare for cargo carriage via railway was 10 Shahi per ton/km which was considered as the cheapest rate in the world but even at this cheap rate, the debt of Allied troops to the government of Iran amounted to nearly 21 thousand million Rials which was a large sum of money at the time.

Picture 2.143: Railroad workers in line to get salary/1929;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Based on the statistical data published after the defeat of Germans, the total shipment by Iranian railway including weaponry and ammunitions was equal to 4380440 tons. In addition, 1380272 tons of merchandise was carried through the roadway network of Iran particularly roads from: Bushehr to Shiraz to Isfahan to Tehran, Zahedan to Mashad to Bajgiran, Khaneqeyn to Kermanshah to Tehran and Kermanshah to Hamadan to Tabriz. Therefore, approximately six million tons of armaments was delivered to the USSR via Iranian roads. Such reckless usage of Iranian roads was the result of a deal put forth by the allied forces called the "tripartite treaty". The deal was inevitably approved by the National Consultative Assembly of Iran in 1941.

On the whole the Trans-Iranian railway which can be regarded as a heritage of the country, was completed despite serious difficulties linking the northern and southern coastlines of Iran.

The date of its completion was 1938 when the south line joined the north line at Someyyeh station. Later after special ceremonies, it was officially inaugurated in 1938. In fact, after eleven years of hard work the first train began its journey from south to north in 1938. It was clear that the southern line from Tehran to the Persian Gulf had been designed considering military and security matters because it passed right through nomadic routes making any potential interference much easier. Also its vital international role during the WWII should not be neglected.

Picture 2.144: The Trans-Iranian railway opening ceremony- Tehran,1938;
Source: The center for document and history of diplomacy, Ministry of foreign affairs (IRI).

Further Expansion of Iranian Railways

Under Pahlavi II, construction of new railway lines was continued as planned during the reign of Pahlavi I. In 1940, before the official completion of the cross-country line, Reza Shah had emphasized on the speedy construction of new lines connecting to destinations like: Mashad, Tabriz and Kerman by the Ministry of Road and Urban Development instead of foreign advisors although they were also involved inevitably (albeit with the least intervention possible) for example the mapping of these new lines was done by an expert engineer by the name of Maber who did the following measurements:

1- The Garmsar-Mashad line which is 811.1 km in length
2- The Tehran –Tabriz line with a length of 742 km
3- The Qom-Kashan-Yazd line which is 471.750 km in length

It was decided to build the Garmsar- Mashad line before the other two; therefore, an engineer by the name of Zakov who had previously served as a department manager in Kampsax Company was appointed as the line supervisor. In fact, construction operation of the Mashad line began in April of 1938 followed by Tabriz line in October and Yazd line in November of the same year. These three lines were planned to be finished by 1st March, 29th March 1941 and Septembr 1942 respectively but on 2nd Septembr 1941 the Mashad line had been completed only as far as Shahrud and remained unfinished due to the events of that month. Years later during the rule of Pahlavi II, the line was completed. Its track-laying began at 9.5 o'clock on Tuesday 3rd March 1954; its inauguration was on 12nd April 1957 and it has been in service ever since.

The Tehran-Tabriz line reached as far as Mianeh during the Second World War but remained unfinished until 1947 when operations were resumed. In 1956 the line reached Maragheh and in 1958 reached Tabriz. After its official inauguration, the line was immediately put into operation. Later the line was extended as far as Turkey and this branch was inaugurated in the presence of the heads of both state in 1971. This meant that the Iranian railway was now linked to Europe via Turkey.

Among other lines built under Pahlavi II was the Qom-Kerman line which had already been mapped during the rule of Pahlavi I who intended to connect the Iranian railway network to the Pakistan one via Qom, Kashan, Yazd, Kerman and Zahedan. The operational phase began in 1938 but the WWII halted it until 1947 on which the track-laying operations were resumed reaching Kashan, 1949. After a long delay, the construction activities were resumed towards Yazd in 1958, later extending as far as Kerman. The line has been in service since Monday, in 1977. Therefore, until 1978 in which the Pahlavi monarchy was overthrown a total of 4605 km of railway lines had been built.

After the victory of the Islamic revolution, a change of plans occurred. Following the end of the Iran-Iraq war, the railway personnel have been busy maintaining and expanding the railway network and the process has been incessantly going on ever since.